"Quality and Consistency of DHS Fertility Estimates, 1990 to 2012"

Schoumaker, Bruno

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QUALITY AND CONSISTENCY OF DHS FERTILITY ESTIMATES, 1990 TO 2012

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Quality and Consistency of DHS Fertility Estimates, 1990 to 2012

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Preface

The Demographic and Health Surveys (DHS) Program is one of the principal sources of international data on fertility, family planning, maternal and child health, nutrition, mortality, environmental health, HIV/AIDS, malaria, and provision of health services.

One of the objectives of The DHS Program is to continually assess and improve the methodology and procedures used to carry out national-level surveys as well as to offer additional tools for analysis. Improvements in methods used will enhance the accuracy and depth of information collected by The DHS Program and relied on by policymakers and program managers in low- and middle-income countries.

While data quality is a main topic of the DHS Methodological Reports series, the reports also examine issues of sampling, questionnaire comparability, survey procedures, and methodological approaches. The topics explored in this series are selected by The DHS Program in consultation with the U.S. Agency for International Development.

It is hoped that the DHS Methodological Reports will be useful to researchers, policymakers, and survey specialists, particularly those engaged in work in low- and middle-income countries, and will be used to enhance the quality and analysis of survey data.

Sunita Kishor

Director, The DHS Program

Abstract

This report evaluates the quality of birth history data from 182 DHS surveys conducted in 69 countries since the 1990s (DHS Phase II onward). It focuses on levels and trends in estimated fertility. Fertility trends are reconstructed using birth history data from DHS surveys; the regularity of trends in fertility and their consistency across surveys draw a broad picture of the quality of data from the 69 countries. The results of the reconstruction indicate that fertility data are very good in some countries (e.g., Armenia, Colombia, Indonesia, Morocco), acceptable in many countries (e.g., Jordan, Kenya, Zimbabwe), and poor in other countries (e.g., Benin, Ethiopia, Niger, Nigeria, Pakistan). The study identified discrepancies between the fertility estimates, published in the survey reports (for the three years preceding the survey) and the reconstructed fertility estimates, and explored various data quality issues that may explain these discrepancies. Displacement of recent births in the birth history table of the DHS questionnaire because of the child health section is widespread, but it is only marginally related to discrepancies between published and reconstructed fertility trends. Three other factors may account for the differences: 1) omission of recent births, 2) the Potter effect, and 3) differences in sample composition. Overall, the analyses presented in this study indicate that DHS fertility estimates are of good or acceptable quality in the majority of surveys, but that taking published fertility figures at face value could be risky in some contexts. Inferring fertility trends by comparing recently published fertility data from successive surveys may lead to erroneous trend results.

KEY WORDS: fertility, data quality, displacement, omission, Potter effect, sample

Executive Summary

Birth histories provide key data for the measurement of fertility indicators (age-specific fertility rates, total fertility rates, length of birth intervals) and child mortality indicators. These indicators are central to designing and evaluating health and population policy, establishing population projections, and documenting the dynamics of population. Such objectives require good quality data.

This report presents an evaluation of the quality of birth history data in 182 DHS surveys conducted in 69 countries since the 1990s (DHS Phase II onward). It focuses on levels and trends in the total fertility rate (TFR) and the reliability of published fertility (three years preceding the survey). The first step in the study was reconstructing fertility trends in each of the 69 countries, using birth history data from DHS surveys. The regularity of the trends observed and their consistency across surveys draw a broad picture of the quality of the fertility data. In countries with several surveys, fertility trends are reconstructed by pooling birth histories from successive surveys. The study identified discrepancies between the published fertility estimates and the reconstructed fertility estimates and explored various data quality issues—displacement of recent births, omission of recent births, the Potter effect, and sampling—that may explain these discrepancies. By manipulating birth histories to correct for potential data quality problems, we evaluated whether some of these issues/problems have an impact on the discrepancies or can be ruled out.

The overall picture emerging from these analyses is that fertility estimates appear to be very good in some countries (e.g., Armenia, Colombia, Indonesia, Morocco), are acceptable in many countries (e.g., Jordan, Kenya, Zimbabwe), and are poor in other countries (e.g., Benin, Ethiopia, Niger, Nigeria, Pakistan). Displacement of recent births in the birth history table of the DHS questionnaire is widespread but the problem is only marginally related to the discrepancies between published and reconstructed fertility trends. Three other factors were explored in 26 surveys where discrepancies were large. First, the Potter effect may account for a portion of the discrepancies in some surveys; second, differences in sample implementation appear to be an important issue in a few surveys. Finally, after correcting for these two data quality problems, omission of recent births may best explain the differences between reconstructed fertility and published fertility.

Overall, these analyses identify broad patterns of data quality that affect birth histories and may be possible sources of errors. Even though consistency across DHS surveys is very good in a majority of countries, the results of this report indicate that data quality is an important consideration. Taking published figures on fertility at face value could be risky in some contexts; likewise, inferring fertility trends by comparing published recent fertility data from successive surveys may lead to erroneous trends results.

1. Introduction and Rationale

Birth histories provide key data for the measurement of fertility indicators (age-specific fertility rates, total fertility rates, length of birth intervals) and child mortality indicators. These indicators are central to designing and evaluating health and population policies, establishing population projections, and documenting the dynamics of population. Such objectives require good quality data (Alkema et al. 2012).

Over the past four decades, birth histories collected first by the World Fertility Survey (WFS) and since the mid-1980s by the Demographic and Health Surveys (DHS) have allowed tremendous progress in knowledge of fertility and child mortality in developing countries. More than 200 surveys have been conducted as part of the DHS program in more than 70 countries. Despite the large investment in efforts to collect high quality data, all surveys are to some extent affected by data quality issues. The collection of retrospective data (full birth histories)—on issues that may be sensitive in contexts where respondents have limited education—is affected by problems such as 1) child's date of birth or age at death is unknown, 2) displacement of date of birth or age at death, and 3) omission of births and deaths. The intensity of these problems depends on a variety of factors including the size and design of the questionnaire, the training of interviewers, and the quality control during fieldwork. Ultimately, data quality problems can influence fertility and mortality indicators; however, while some indicators may be severely biased by data quality problems, other indicators may experience only benign effects.

The objective of this report is to evaluate the quality of birth history data in 182 DHS surveys conducted in 69 countries since the 1990s (DHS Phase II onward). It focuses on levels and trends in the total fertility rate (TFR) and the reliability of published fertility data (three years preceding the survey). The first step in the study was reconstructing fertility trends in each of the 69 countries, using birth history data from DHS surveys. The regularity of the trends observed and their consistency across surveys draw a broad picture of the quality of the fertility data. In countries with several surveys, fertility trends are reconstructed by pooling birth histories from successive surveys. The study identified discrepancies between the reconstructed fertility estimates and the published estimates and explored various data quality issues—displacement of recent births, omission of recent births, Potter effects, and sampling issues[1]—that may explain these discrepancies. By manipulating birth histories to correct for potential data quality problems, we evaluate whether some of these issues/problems have an impact on the discrepancies or can be ruled out. Rather than quantifying in a precise way the role of each data quality issue, we evaluate the plausibility of different types of errors. Compared to previous analyses of consistency of fertility estimates across surveys (Arnold 1990; Marckwardt and Rutstein 1996; Pullum 2006), this study focuses on the causes of inconsistencies across surveys and the discrepancies between published fertility estimates and fertility estimated from pooled survey data; it also covers a much larger set of surveys than was the case in previous reports.

The large number of countries and surveys included in this report allows drawing a broad picture of the data quality issues found in these surveys. However, covering such a large number of surveys precludes an in-depth analysis of each country, let alone each survey. Data from specific countries are used to illustrate the variety of situations found in DHS surveys, but most results and comments presented in the text refer to broad patterns and groups of countries or surveys, rather than to specific cases. Nevertheless, figures are provided for each country and survey in the appendix, and may reassure users on the quality of the data or draw attention to specific problems and the need for more detailed investigation in specific cases.

[1] Because this approach relies on combining data from more than one survey, it can only be carried out in countries with at least two surveys, and the most recent published fertility estimates (latest survey) cannot be evaluated in this way.

The study is organized as follows: A brief literature review is presented in section 1. The data and methods are presented in section 2. Results are presented in section 3, starting with the reconstructed fertility trends and their consistency across surveys, followed by the discrepancies between published fertility and reconstructed fertility, and last, by an exploration of the possible causes of these discrepancies. Conclusions are presented in section 4.

1.1. Literature Review: Quality of Birth History Data

Since the 1970s, birth histories have become the major tool for collecting fertility data in less developed countries. Over the last four decades, analyses of WFS and DHS data quality have shown that birth history data are subject to various types of errors. Four broad types of errors that can lead to biases are usually distinguished (Goldman, Rutstein, and Singh 1985): misreporting of date of birth, omission of births, selection bias, and sampling design. Some errors can be further distinguished according to whether they concern recent births or births that took place some distance in the past. In addition, errors in data not collected in the birth histories may also influence fertility estimates. The main types of data quality problems are shown in Table 1 and are discussed below. Four of these problems (Table 1, shaded text) will be explored in this report.

Misreporting of date of birth occurs for various reasons but generally because the respondent does not know the child's exact date of birth. The problem is usually more common in low income countries and among less educated women (Pullum 2006). Incomplete information on date of birth is also more common for dead children (Curtis 1995). When respondents do not know exact birth dates, these are estimated using probing techniques; when no estimate is available, imputation methods are used to provide birth dates. Not knowing exact date of birth can lead to several types of misreporting of birth dates. Heaping on year of birth (e.g., 2000, 2005, 2010, etc.) or on duration since birth (e.g., 5 years, 10 years, etc.) is frequently an issue. Pullum (2006) found that heaping of date of birth on years with final digits 0 or 5 was common in surveys from sub-Saharan Africa. Gage (1995) also showed considerable heaping of year of first birth and duration since first birth on digits 0 and 5 in the early DHS surveys (Phase 2) in sub-Saharan Africa. Misreporting of date of birth can translate into the so-called "Potter effect." The Potter effect results from a tendency among women to report that their first birth occurred later than it actually did, while recent births are reported correctly. As a result, recent fertility will be correct, fertility in more distant periods will be underestimated, and fertility in the intermediate period will be overestimated (Goldman 1985; Moultrie 2013). Misreporting may also be intentional. There is considerable evidence that recent births tend to be displaced backward in some DHS surveys, especially in sub-Saharan Africa (Arnold 1990; Curtis 1995; Pullum 2006). This is linked to the fact that some interviewers may change the birth date of certain children to avoid administering the lengthy child health section of the DHS questionnaire (Arnold 1990; Pullum 2006). The effects of displacement of births on fertility indicators depends on the *extent* of displacement and on the *correspondence* between the cutoff date for the collection of child health information and the period for which rates are computed (Arnold 1990). In the DHS program, fertility rates are most often reported for the three years preceding the survey, and births are thought to be transferred mainly from the fifth to the sixth year before the survey, so displacement would have little or no impact on estimates of recent fertility (Marckwardt and Rutstein 1996).

Table 1. Description of main data quality problems affecting fertility estimates

Type of problem	Possible causes and mechanisms	Impact on fertility
Misreporting of date of birth		
Heaping	Heaping of year of birth or age (e.g., final digit 0 or 5). More likely in contexts where exact date of birth/death is not known by respondent.	Irregular fertility trends; underestimation of recent fertility if heaping implies displacement of births outside the window of eligibility for computation of rates.
Displacement of recent births before the cutoff date	Displacement of births by interviewer or respondent in order to avoid additional questions to complete the child health section in the DHS questionnaire.	Irregular fertility trends; underestimation of recent fertility if births are displaced outside the window of eligibility for computation of rates.
Potter effect	Tendency to report distant births as closer to the survey than actually occurred. More likely when birth histories are collected starting with first birth.	Underestimation of fertility in earlier periods and overestimation in intermediate periods (U-shape trend in fertility); apparent decrease in median age at first birth.
Underreporting of births		
Omission of distant births	Involuntary omission of early births, especially by older respondents and for deceased children.	Underestimation of fertility in earlier periods; apparent decrease in median age at first birth.
Omission of recent births	Omission of births by interviewers or respondents in order to avoid additional questions to complete the child health section in the DHS questionnaire. Omission of deceased children in order to avoid sensitive questions.	Underestimation of recent fertility.
Sample implementation		
Sample implementation	Accidental oversampling or undersampling of some groups of women; this may be due to an outdated sampling frame.	Overestimation or underestimation of the level of fertility, including the published TFR.
Selection bias		
Mortality	Only surviving women are interviewed about their past fertility.	Slight underestimation of recent fertility if fertility and mortality are positively correlated. Fertility at young ages among older women may be underestimated if high fertility women experience higher mortality rates.
International migration	Only women who have survived to international migration are interviewed about their past fertility. International migrants are also included in the computation of past fertility.	Likely to be small, unless the share of international migrants is large and the correlation with fertility is strong.

(Continued...)

Table 1. – *Continued*

Type of problem	Possible causes and mechanisms	Impact on fertility
Other factors		
Misreporting of women's age	Heaping on year of birth or age (e.g., final digit 0 or 5). Women may also be reported as younger or older than they actually are, to avoid being interviewed.	Possible impact on fertility rates if misreporting of age is related to fertility.
All women factor	The percentage of ever-married women by age is needed to compute exposure in surveys conducted among ever-married women. The proportion of ever-married women at younger ages may be underestimated.	Underestimation of ever-married women will lead to underestimation of fertility rates.

Note: Shaded lines indicate data quality problems explored in this report.

Omission of births is another potential data quality issue in birth histories (Blacker 1994; Goldman 1985; Schoumaker 2011). Early evaluations of the quality of birth histories in the World Fertility Survey (WFS) led to the conclusion that omission of distant births was most likely to occur among older women (United Nations 1987). Omission of distant births translates into an underestimation of past fertility and an apparent decrease in age at first birth (Arnold 1990). A decrease in the median age at first birth was found in 9 of the first 11 DHS surveys in sub-Saharan Africa (Arnold 1990), indicating possible omissions among older women. Gage (1995) found similar results in DHS Phase 2 surveys in sub-Saharan Africa. Such patterns may suggest omission of distant births but are also consistent with forward displacement of age at first birth and the Potter effect (Arnold 1990; Gage 1995).

Omission of *recent births* has been less studied but is potentially a very serious issue for the estimation of recent fertility. The same reason that may cause interviewers to displace births in the birth history table—i.e., the lengthy child health section in the DHS questionnaire—may lead them to omit births altogether (Marckwardt and Rutstein 1996). Omission of recent births leads to underestimating recent fertility; if omissions of deceased children are more likely than omissions of surviving children, mortality estimates will also be underestimated (Curtis 1995; Sullivan, Bicego, and Rutstein 1990). Previous analyses of data quality have suggested that a few DHS surveys were affected by severe omission but that, overall, omission of births was not widespread. Marckwardt and Rutstein (1996) analyzed the distribution of births by calendar year in 25 DHS surveys and concluded that three surveys (Indonesia 1991, Pakistan 1990-91, and Yemen 1991-92) were affected by substantial omission. Omissions of deceased children were confirmed in Pakistan with a reinterview survey (Curtis and Arnold 1994). Evidence of severe omission was also reported in more recent DHS surveys. For instance, in the 1999 Nigeria DHS, "[…] omission of births in the three-year period immediately prior to the survey […resulted] in an underestimate of current fertility of about 16-17 percent" (National Population Commission 2000:36). However, identification and quantification of omission is not an easy task unless underreporting is severe (Arnold 1990; Marckwardt and Rutstein 1996). Displacement and omission may lead to similar distortions in fertility trends (Arnold 1990; Goldman 1985; Sullivan, Bicego, and Rutstein 1990), making it difficult to distinguish these two broad issues. Internal consistency checks such as the measurement of sex ratio at birth and the ratio of neonatal mortality to infant mortality also have limitations because they can only detect selective omissions (Curtis 1995). When two or more surveys are available, a useful approach to evaluating the data quality of birth histories consists of comparing the level of fertility in one survey with the level of fertility estimated for the same period in the subsequent survey. Good consistency in fertility levels across surveys provides solid evidence of good quality of birth histories. In contrast, discrepancies may reflect several types of data quality issues, including omission. This approach has been used in several DHS country reports as well as in comparative papers (Arnold 1990; Machiyama 2010; Pullum 2006). Overall, discrepancies between TFRs (for women age 15-44) from successive surveys may be large, especially in sub-Saharan Africa (Pullum 2006). Omission of recent births may account for part of these discrepancies.

Selection bias is related to the fact that only surviving women are interviewed about their past fertility. If fertility and mortality are correlated, and if a large proportion of women have died before a given age, fertility estimates may be biased. In most instances, this should not have a strong impact; the risk of dying in the few years preceding the survey at adult ages is usually low. Combined with moderate fertility differences between surviving and deceased women, the overall impact should be small. In contrast, fertility at young ages among older women may be underestimated if high fertility women experience high mortality rates. Selection may also occur because of migration (out-migration and in-migration), but the overall impact on national fertility estimates should be small because, in most cases, levels of international migration are low.[2]

Fertility estimates also depend on the sample design. While this is not a characteristic of birth histories, it can potentially substantially influence fertility estimates. Accidental oversampling or undersampling of women with high fertility—e.g., rural areas are overrepresented or underrepresented in the sample—will translate into overestimated or underestimated fertility rates. Such situations are more likely to occur if the sampling frame is outdated. Unless the data can be compared with other sources, these problems are difficult to detect.

Finally, other types of data quality issues may affect fertility estimates. The quality of age reporting of mothers may influence fertility estimates if misreporting of mother's age relates to fertility. Information on marital status may influence the quality of estimates in surveys conducted among ever-married women. In these surveys, *all women factors* are derived from the percentage of ever-married women by age, to estimate exposure for the computation of general age-specific fertility rates (Rutstein and Rojas 2006). This factor is sensitive to age reporting and may thus also influence fertility estimates (Curtis and Arnold 1994).

Overall, the number of potential data quality errors in estimating fertility is large. Errors may occur simultaneously, or different errors may have similar effects on fertility estimates. As a result, evaluating the existence of these errors and, more important, quantifying their extent, has no ready-made solution. Instead, a variety of approaches should be used to reach *an acceptable assessment of the quality of birth histories and the sources of possible data problems*. This report aims to contribute to this assessment by implementing a combined approach to the problem of data quality errors. The consistency of estimates from several sources is a key element in this approach. The causes of inconsistencies are investigated with specific attention to displacement of recent births, omission of recent births, sample implementation, and Potter effects.

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[2] Impacts may be larger for subnational estimates.

2. Data and Methods

2.1. DHS Data Used in the Study

The data for this study come from 182 DHS surveys conducted from the early 1990s to 2012, for which access to data was unrestricted. These surveys were conducted in 69 countries under DHS Phase 2 through Phase 6. The number of surveys carried out by each country varied: 23 countries conducted one survey during the study period while 24 countries had four or more surveys (Table 2). Only standard DHS surveys are used in this report; full birth histories have been collected in some MIS and AIS surveys, but these surveys were not included.

Table 2. Distribution of 69 countries included in this study, by number of DHS surveys conducted in the country

Number of DHS surveys	Number of countries
1	23
2*	11
3	11
4	18
5	4
6	2
Total	69

* Two surveys were conducted in Brazil, but the geographic coverage of the two surveys in Brazil is not comparable.

Table 3 presents the surveys by broad regions and by DHS phase. With 93 surveys, sub-Saharan Africa includes approximately half of the surveys used in this report, and is by far the most represented region. Thirty-six surveys were conducted in Asia, and 31 surveys were conducted in Latin America. A total of 15 surveys were carried out in the Middle-East and North Africa (MENA). A few surveys (7) have also been conducted in Eastern Europe since Phase 4.

Table 3. Number of DHS surveys used in this report, by region and phase

	Phase					
Region	II (1988-1993)	III (1992-1997)	IV (1997-2003)	V (2003-2008)	VI (2008-2013)	Total
Sub-Saharan Africa (SSA)	11	22	26	20	14	93
Asia (ASIA)	3	11	9	8	5	36
Europe (EU)	0	0	1	5	1	7
Latin America (LA)	5	9	7	7	3	31
Middle-East and North Africa (MENA)	4	3	5	3	0	15
Total	23	45	48	43	23	182

2.1.1. Birth histories

The analyses in this study use data from birth histories collected with the DHS Woman's Questionnaire. In the DHS Program, birth history data are collected using the birth history table that records "[…] all the births the respondent has had in the order in which they occurred starting with her first birth" (ICF International 2012:52). This "forward approach" is the same as that used in the World Fertility Survey (Goldman 1985).[3] Each line in the table corresponds to a live birth, and the 10 columns correspond to the 10 questions related to each live birth (Figure 1).

Figure 1 shows the information collected in birth histories in DHS Phase 6. The content of birth histories in DHS has changed slightly since the 1990s, but the core of the birth history table (questions Q212 to Q218 and Q220) has been collected in a fairly consistent manner.[4] In some surveys, birth histories were collected as part of pregnancy histories (e.g., Ghana 1998), with a few additional questions to distinguish between live births, stillbirths, and pregnancy losses. The phrasing of questions may also have varied across surveys but, overall, the manner in which birth history data have been collected in DHS surveys makes it highly comparable. Most DHS surveys administer the individual questionnaire to all women age 15-49, regardless of marital status; in some countries (e.g., Morocco, Bangladesh), only ever-married women are interviewed. As mentioned earlier, in these countries, an *all women factor* is used to compute general fertility rates from data collected among ever-married women (Rutstein and Rojas 2006).

[3] This is one element that may lead to the Potter effect (Potter 1977).

[4] Some of these questions have not changed (Q216, Q220) or have changed only slightly (Q214). For some of these questions, some precisions were added or removed. For instance, for the date of birth (Q215), the following precision "OR In what season was he/she born?" was removed from the questionnaire in DHS Phase 5 and Phase 6. The order of some questions was changed (Q213 comes before Q214 in DHS Phase 6, but not in previous phases). Some questions were also added, and some were removed. Q219 (household line number of the child) was added in DHS Phase 4. Q221 (any other live births since the previous birth) was added in DHS Phase 3, in combination with a question on the duration of the preceding birth interval. The question on the preceding birth interval was removed in DHS Phase 4, and a further precision ("including any children who died after birth?") was brought to Q221 in DHS Phase 5. Overall, the changes have been limited.

Figure 1. Birth history table

211 Now I would like to record the names of all your births, whether still alive or not, starting with the first one you had.
RECORD NAMES OF ALL THE BIRTHS IN 212. RECORD TWINS AND TRIPLETS ON SEPARATE ROWS.
(IF THERE ARE MORE THAN 12 BIRTHS, USE AN ADDITIONAL QUESTIONNAIRE, STARTING WITH THE SECOND ROW).

212 What name was given to your (first/next) baby? RECORD NAME. BIRTH HISTORY NUMBER	213 Is (NAME) a boy or a girl?	214 Were any of these births twins?	215 In what month and year was (NAME) born? PROBE: When is his/her birthday?	216 Is (NAME) still alive?	217 IF ALIVE: How old was (NAME) at his/her last birthday? RECORD AGE IN COM-PLETED YEARS.	218 IF ALIVE: Is (NAME) living with you?	219 IF ALIVE: RECORD HOUSE-HOLD LINE NUMBER OF CHILD (RECORD '00' IF CHILD NOT LISTED IN HOUSE-HOLD).	220 IF DEAD: How old was (NAME) when he/she died? IF '1 YR', PROBE: How many months old was (NAME)? RECORD DAYS IF LESS THAN 1 MONTH; MONTHS IF LESS THAN TWO YEARS; OR YEARS.	221 Were there any other live births between (NAME OF PREVIOUS BIRTH) and (NAME), including any children who died after birth?
01	BOY 1 GIRL 2	SING 1 MULT 2	MONTH YEAR	YES . . 1 NO . . . 2 220	AGE IN YEARS	YES . . . 1 NO 2	HOUSEHOLD LINE NUMBER (NEXT BIRTH)	DAYS . . . 1 MONTHS 2 YEARS . . 3	
02	BOY 1 GIRL 2	SING 1 MULT 2	MONTH YEAR	YES . . 1 NO . . . 2 220	AGE IN YEARS	YES . . . 1 NO 2	HOUSEHOLD LINE NUMBER (GO TO 221)	DAYS . . . 1 MONTHS 2 YEARS . . 3	YES . . . . 1 ADD BIRTH NO . . . . . 2 NEXT BIRTH
03	BOY 1 GIRL 2	SING 1 MULT 2	MONTH YEAR	YES . . 1 NO . . . 2 220	AGE IN YEARS	YES . . . 1 NO 2	HOUSEHOLD LINE NUMBER (GO TO 221)	DAYS . . . 1 MONTHS 2 YEARS . . 3	YES . . . . 1 ADD BIRTH NO . . . . . 2 NEXT BIRTH
04	BOY 1 GIRL 2	SING 1 MULT 2	MONTH YEAR	YES . . 1 NO . . . 2 220	AGE IN YEARS	YES . . . 1 NO 2	HOUSEHOLD LINE NUMBER (GO TO 221)	DAYS . . . 1 MONTHS 2 YEARS . . 3	YES . . . . 1 ADD BIRTH NO . . . . . 2 NEXT BIRTH
05	BOY 1 GIRL 2	SING 1 MULT 2	MONTH YEAR	YES . . 1 NO . . . 2 220	AGE IN YEARS	YES . . . 1 NO 2	HOUSEHOLD LINE NUMBER (GO TO 221)	DAYS . . . 1 MONTHS 2 YEARS . . 3	YES . . . . 1 ADD BIRTH NO . . . . . 2 NEXT BIRTH
06	BOY 1 GIRL 2	SING 1 MULT 2	MONTH YEAR	YES . . 1 NO . . . 2 220	AGE IN YEARS	YES . . . 1 NO 2	HOUSEHOLD LINE NUMBER (GO TO 221)	DAYS . . . 1 MONTHS 2 YEARS . . 3	YES . . . . 1 ADD BIRTH NO . . . . . 2 NEXT BIRTH
07	BOY 1 GIRL 2	SING 1 MULT 2	MONTH YEAR	YES . . 1 NO . . . 2 220	AGE IN YEARS	YES . . . 1 NO 2	HOUSEHOLD LINE NUMBER (GO TO 221)	DAYS . . . 1 MONTHS 2 YEARS . . 3	YES . . . . 1 ADD BIRTH NO . . . . . 2 NEXT BIRTH

Source: ICF International (2012)

2.1.2. Cutoff date for the health sections

At the end of the birth history, the interviewer is asked to count the number of live births the respondent has had since a specified cutoff date. The births between the cutoff date and the date of the survey are eligible for the health questions administered in various parts of the questionnaire, particularly the lengthy child health section. The number of eligible births reported by the interviewer comes directly from the data collected in the birth history table and may strongly influence the quality of the birth history data. As discussed in section 1.1 above, interviewers may be tempted to change the date of birth of children to limit their workload (i.e., avoid asking the same series of questions for each eligible birth), leading to displacement of births backward. Interviewers may also omit births to avoid the time-consuming child health section.

In most surveys, the cutoff date corresponds to the month of January for the year of the beginning of the survey minus five years. For instance, for a survey conducted from March to August 2001, the cutoff date would be January 1996. The reference period for the child health sections is, on average, around 5.5 years in these surveys (Figure 2). In approximately 1 in 10 surveys, the reference period was shorter than five years (an average of 3.5 years), with the cutoff date defined as the month of January for the survey year minus three years (Table 4). These shorter reference periods were used in the Phase 3 and Phase 4 surveys and mainly involved countries in sub-Saharan Africa and Asia (e.g., Bangladesh 1994, Ghana 1993, Mozambique 1997, Togo 1998, Zimbabwe 1994, etc.).

Figure 2. Distribution of 182 DHS surveys by length of the reference period (months) for the child health section in the DHS questionnaire. (The length of the reference period is computed as the difference between the mean date of the survey and the cutoff date for the child health section.)

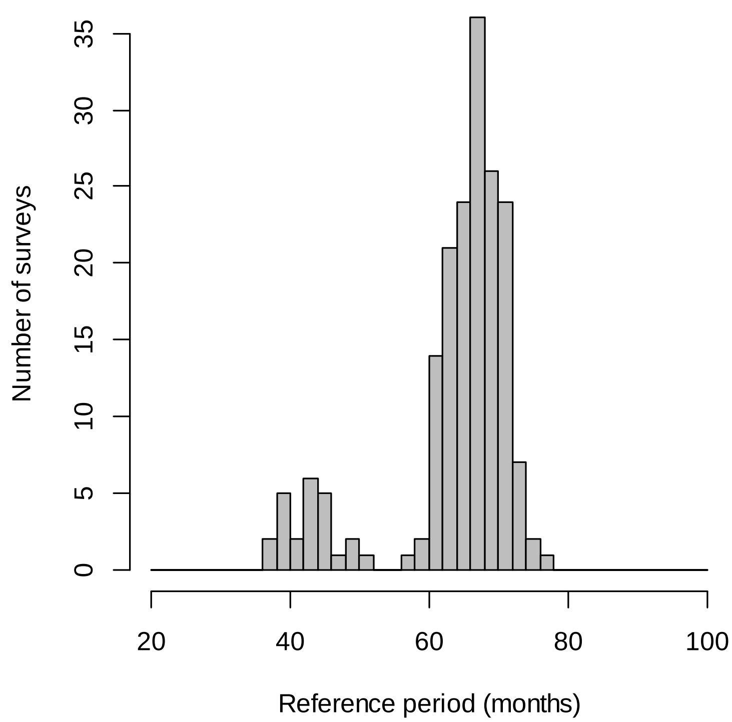

Table 4. Percentage of DHS surveys with a short reference period (<4 years) for the child health section in the questionnaire, by region and phase

Region	Phase II (1988-1993)	Phase III (1992-1997)	Phase IV (1997-2003)	Phase V (2003-2008)	Phase VI (2008-2013)	Total
Sub-Saharan Africa (SSA)	0%	55%	4%	0%	0%	14%
Asia (ASIA)	0%	45%	11%	0%	0%	17%
Europe (EU)	0%	0%	0%	0%	0%	0%
Latin America (LA)	0%	0%	14%	0%	0%	6%
Middle-East and North Africa (MENA)	0%	0%	0%	0%	0%	0%
Total	0%	38%	6%	0%	0%	11%

2.2. Methods

This methodological report relies to a large extent on reconstructed fertility trends as a tool to evaluate the quality of birth histories and fertility estimates. Two broad approaches are used in this study to reconstruct fertility trends from birth history data. The first consists of reconstructing trends in the total fertility rate (TFR) for each survey separately. In countries where several DHS surveys have been conducted, the consistency of fertility trends from successive surveys provides a powerful way to evaluate data quality. The second approach consists of pooling all the surveys conducted in the same country and reconstructing smoothed fertility trends from the pooled dataset. The pooled reconstructed trend is then used as a reference for evaluating the quality of published fertility estimates. The possible impact of specific types of errors on fertility estimates is evaluated by manipulating birth histories to correct for data quality problems.

2.2.1. Reconstruction of fertility trends from a single survey

Fertility is reconstructed using Poisson regression. For a single survey the method consists of creating a table of births and exposure by periods and by 5-year age groups of mothers from the birth history data. A Poisson model is then fitted with the number of births as the dependent variable, exposure as an offset, and two independent variables: 1) *age* measured with dummy variables for 5-year age groups, and 2) *periods* measured with dummy variables. The total fertility rate between age 15 and age 49 can be reconstructed for each period from the regression coefficients. This age-period model makes the assumption that the age pattern of fertility is constant over time, i.e., that there is no interaction between age and time periods. Although this does not hold strictly, simulations show that the assumption is reasonable for periods up to 15 years. Two types of periods are used for the reconstructions. In the first series of reconstructions fertility is computed by single calendar years over 15 years. In the second series, fertility is computed by three-year periods preceding the survey for the last 15 years. A similar approach is used to reconstruct partial total fertility rates (15-24) over long periods (30 years) to evaluate the existence of a Potter effect. The method for reconstructing fertility in this way is presented in detail in Schoumaker (2013b), and a *Stata* module implementing the method is available.[5]

[5] The Stata module can be installed directly from Stata by typing ssc install tfr2.

2.2.2. Reconstruction of fertility trends from pooled surveys

Trends in total fertility rates (15-49) can also be reconstructed over longer periods by pooling birth histories from several surveys. The method, which is an extension of the method for a single survey, is presented in detail in Schoumaker (2013a). For each survey in a country, a table of births and exposure for the 15 years preceding the survey is prepared. These tables are then simply appended to create a table covering a longer period. As with the previous method, fertility rates are estimated with Poisson regression, with age and time periods included as independent variables. Contrary to the single survey approach, the age pattern of fertility *is not* considered to be constant for the entire period, but *is* considered to be constant for each survey. This is done by computing a *pattern of proportional age-specific fertility rates* for each survey; the pattern is multiplied by exposure and controlled for in the offset.[6] Total fertility rates are also smoothed by using restricted cubic splines (Schoumaker 2013a). This method is useful to provide an average TFR estimate based on data from all the surveys combined. When successive surveys are highly consistent, the reconstructed fertility trend for successive surveys will correspond to estimates from separate surveys. When the surveys do not match, the reconstructed trend will provide a reference for quantifying discrepancies.

2.2.3. Manipulating birth histories

Individual birth histories can be manipulated in different ways to evaluate the impact of data quality on fertility estimates. One approach consists of introducing measurement errors in good quality birth histories (e.g., displacing births, removing births) to evaluate the impact of different types of errors on fertility levels and trends and on consistency across surveys. Another approach consists of trying to *correct* for measurement errors in birth histories that are thought to be affected by data quality issues. Births may be displaced (or added) to evaluate the extent to which correcting for some types of errors improves consistency across surveys. In this study the second approach is used to explore the possible impact of two specific problems: displacement of recent births and the Potter effect. For the first problem, a percentage of births are displaced from the cutoff year of the child health sections to the year just before, to correct for the backward displacement of births. Births are randomly selected and displaced in individual birth histories to correct for the distribution of births at the aggregate level.[7] For the second problem, the Potter effect, all the births occurring before the cutoff year are displaced backward. This is done by increasing the length of birth intervals by a given percentage (10 percent). In this way, births that occurred a longer time before the survey—those at young ages among older cohorts—are displaced to a larger extent than those that occurred more recently. These approaches are further explained in sections 3.3.2. and 3.3.4.

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[6] Several age patterns are thus used for periods in which several surveys overlap. As a result, the age pattern is an average of several age patterns for these periods. Simulations and applications to data from the Human Fertility Database indicate the method is able to reproduce known fertility trends accurately (Schoumaker 2013a).

[7] One should note that consistency *within* birth histories is not necessarily respected using this approach; however, because the objective of this method is to evaluate errors in birth histories on aggregate measures, inconsistencies within birth histories created in this way are not a problem for our purpose.

3. Results

3.1. Reconstructed Fertility Trends by Calendar Year: Regularity and Consistency across Surveys

Total fertility rates for each of the 182 DHS surveys in this study were reconstructed by single calendar year for the last 15 years (Appendix Figure A1).[8] Published values of total fertility rates (computed over the three years preceding the survey) are represented on these figures as red dots.[9] The smoothed reconstructed fertility trend with pooled birth histories is also represented on these figures. The quality of fertility data is first interpreted by visual inspection of fertility trends. With good quality data, we expect the fertility trends from successive surveys to match, fluctuations to be small, and the red dots (published fertility) to be located on or close to the reconstructed trends. In countries with only one survey, the evaluation of data quality is less straightforward. The regularity of the fertility trends is used as an indicator of quality. In contrast, large fluctuations[10] and a sharp decrease a few years before the survey—at the cutoff date for the child health section—are interpreted as data quality problems.

Six reconstructed fertility trends for the Philippines, Colombia, Niger, Ethiopia, Ghana, and Bolivia are described below and compared with published fertility data (Figure 3). The results for all 69 countries are reported in Appendix Figure A1. Overall, these trends indicate that data quality varies greatly across surveys and countries from excellent to very poor. Data from the Philippines and Colombia illustrate highly consistent fertility trends. Annual variations in the TFR are small; the reconstructed trends match quite well and are very close to the smoothed trend (thick black line); and the published TFRs (last three years) are located along the fertility trend. Even though the retrospective estimates do not match perfectly, they are close to one another and the published estimates do not depart from the overall trend in a significant way. In contrast, fertility trends for Niger and Ethiopia are affected by severe data quality problems. Fertility estimates from successive surveys are not very consistent; annual values of the TFRs vary widely; and estimates of recent fertility (last three years) are much lower than the retrospective estimates at the same time from the following surveys and are lower than the TFRs estimated with pooled survey data. The published three-year TFR in the second survey in Niger is almost two children lower that the retrospective estimate from the third survey. A similar situation is seen in Ethiopia, where fertility decreases sharply in the few years before the survey and published TFRs are well below other estimates. For the most recent surveys in Niger and Ethiopia, the reconstructed estimate and the published estimate are very close to each other because only one survey is available. In countries with questionable data quality, the reconstructed trend for the most recent period should not be given too much confidence. Intermediate fertility trends are illustrated by data from Ghana and Bolivia. In Ghana, TFRs fluctuate more than in the Philippines and Colombia, and the published TFR in the 1998 Ghana survey (second survey shown) is below the fertility trend. In Bolivia, fluctuations are also larger than in the Philippines and Colombia and the first two estimates of recent fertility appear to be well below the fertility trend. In addition to possible displacement and/or omission of births, the estimate from the second survey in Bolivia may be lower than the other estimates because of differences in sample implementation.

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[8] In Brazil, only the survey covering the entire country is shown, as the two surveys are not comparable. As a result, 181 surveys are represented on the figures.

[9] We refer to rates for the three years preceding the survey as "published fertility rates." Published TFRs in country reports may sometimes be computed for the five years preceding the survey, but TFRs on the STATcompiler cover the three years preceding the survey.

[10] Some fluctuations may reflect real fluctuations in the TFR, some are due to sampling errors, and some reflect heaping on some dates or ages. Given that sample sizes are fairly similar across surveys, the larger fluctuations are interpreted as reflecting data quality problems.

Figure 3. Reconstructed fertility trends (TFR 15-49) and comparison with published TFRs (Philippines, Colombia, Niger, Ethiopia, Ghana, and Bolivia)

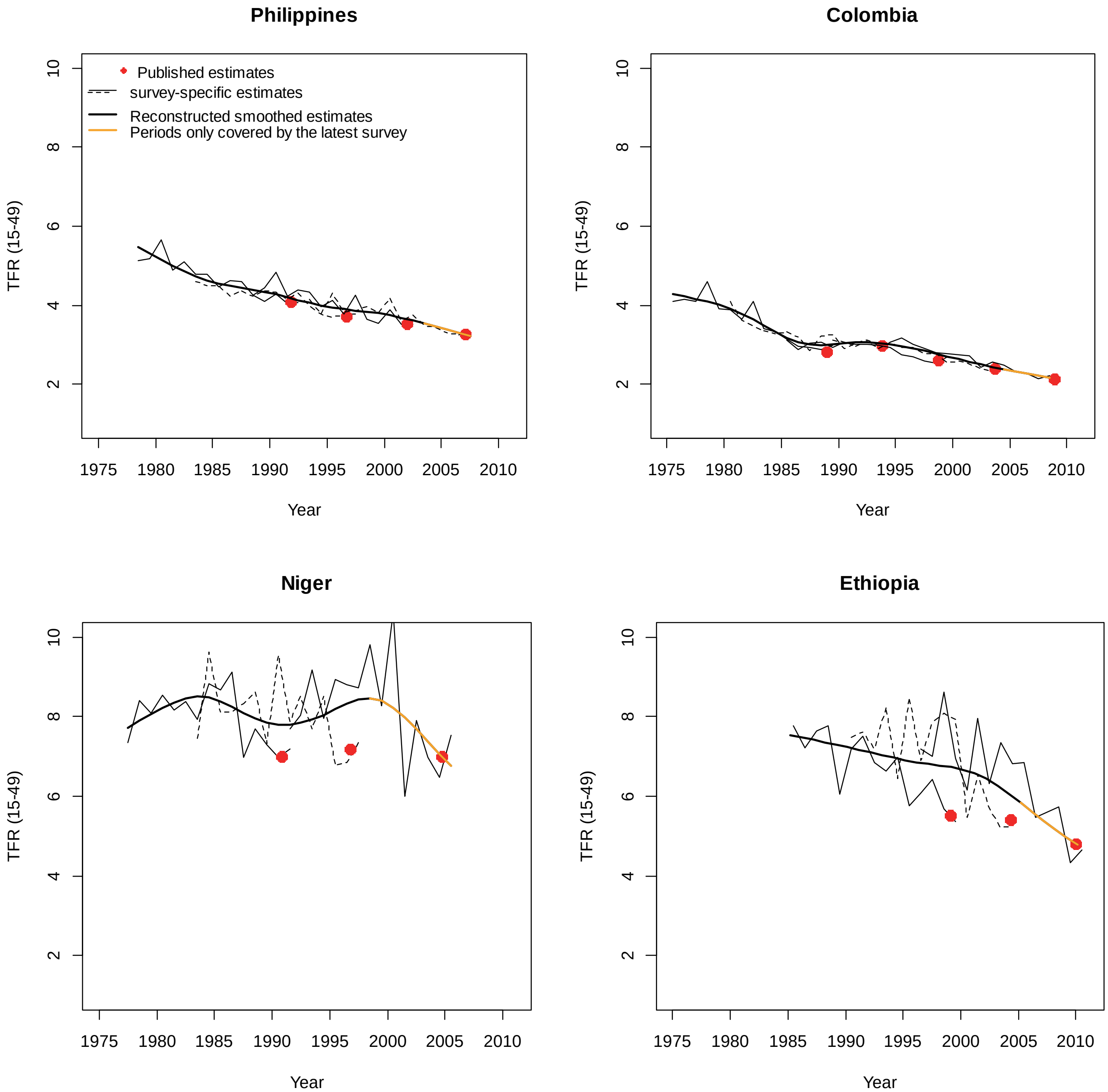

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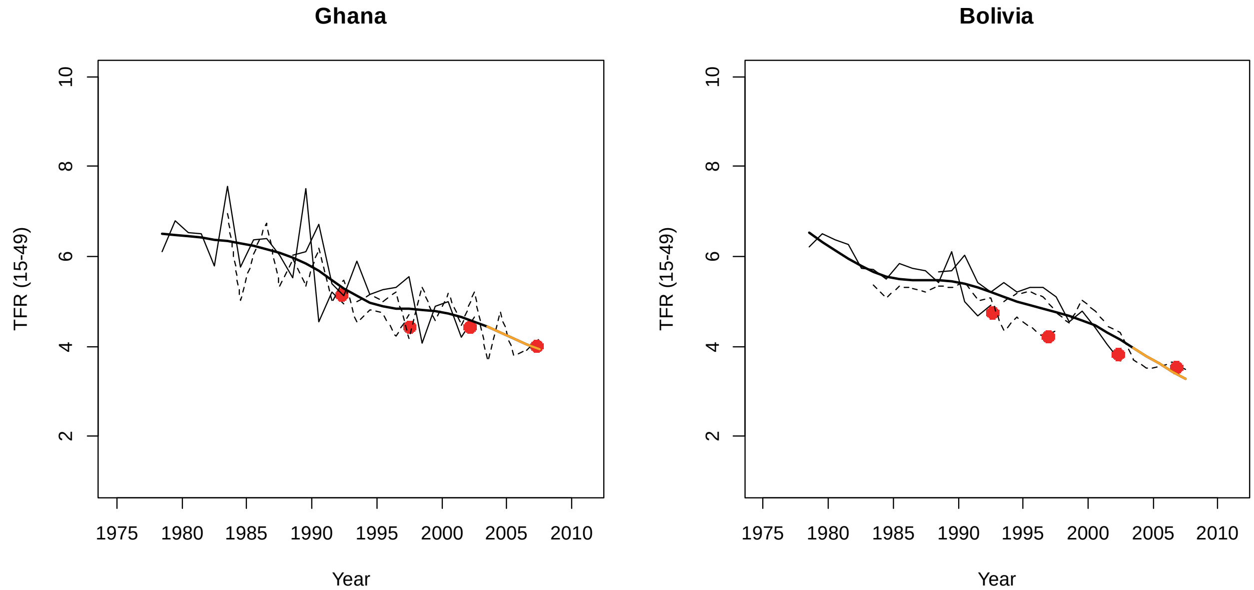
Figure 3. – *Continued*



Note: Because only one survey is available for the recent period, the most recent published estimate necessarily falls on the trend line. This is a structural feature, not an indication that data are of good quality. For this reason, the section of the reconstructed trend based on a single survey for the most recent period is shown in a different color.

Overall, in the 45 countries with more than one survey, consistency across surveys is very good in 16 countries, moderate in 16 countries, and low in 13 countries (Table 5). Most countries with severe inconsistencies are in sub-Saharan Africa. In the 24 countries with only one survey, fertility trends show considerable variation in data quality across countries. In 10 of these countries, fluctuations in fertility are small and changes are regular. In 9 other countries, fluctuations are larger and changes are less regular, especially in the few years preceding the survey. Finally, fertility in 5 countries appears very erratic and the reconstructed trend indicates a sharp decrease a few years before the survey, reflecting possible omission and/or displacement of births.

This visual evaluation of reconstructed trends is to some extent subjective but clearly shows that data quality ranges from excellent to very poor. Overall, birth histories in about a quarter of the 69 countries are affected by serious data quality issues, mainly in sub-Saharan Africa and in a few Asian countries (Pakistan, Timor Leste, and Yemen). Fertility trends appear of good quality in 26 of the 69 countries, and quality is intermediate in 25 countries.

Table 5. Evaluation of data quality based on consistency of fertility trends across surveys in countries with more than one DHS survey and on the regularity of fertility trends in countries with one DHS survey

Subjective evaluation of quality (Degree of consistency/regularity)	**Countries with more than one survey (45 countries)**	**Countries with one survey (24 countries)**
Good quality (High consistency/regularity) *16+10 countries*	Armenia, Colombia, Egypt, Gabon, Honduras, Indonesia, Kazakhstan, Morocco, Lesotho, Nicaragua, Namibia, Nepal, Peru, Philippines, Vietnam, Zimbabwe	Albania, Azerbaijan, Brazil, Guyana, Kyrgyz Republic, Moldova, Maldives, Paraguay, Ukraine, Uzbekistan
Moderate quality (Moderate consistency/ regularity) *16+9 countries*	Bangladesh, Bolivia, Cambodia, Côte d'Ivoire, Dominican Republic, Ghana, Haiti, India, Jordan, Kenya, Malawi, Rwanda, Senegal, Tanzania, Turkey, Zambia	Burundi, DR Congo, Congo Brazzaville, Guatemala, Comoros, Sao Tome, Togo, Swaziland, South Africa
Poor quality (Low consistency/regularity) *13+5 countries*	Burkina Faso, Benin, Cameroon, Chad, Ethiopia, Guinea, Madagascar, Mali, Mozambique, Nigeria, Niger, Pakistan, Uganda	Central African Republic, Liberia, Sierra Leone, Timore Leste, Yemen

3.2. Discrepancies between Published Fertility and Reconstructed Fertility

Published total fertility rates are of central importance in DHS publications. In most survey reports the TFR is presented for the three years preceding the survey and indicates the level of *recent fertility*. Fertility changes are often evaluated by comparing recent fertility from successive surveys. However, as shown in Figure 3, published fertility (red dots) can be much lower than reconstructed fertility, *suggesting that published fertility may be underestimated*. Variations in the degree of underestimation across surveys may lead to erroneous trends.

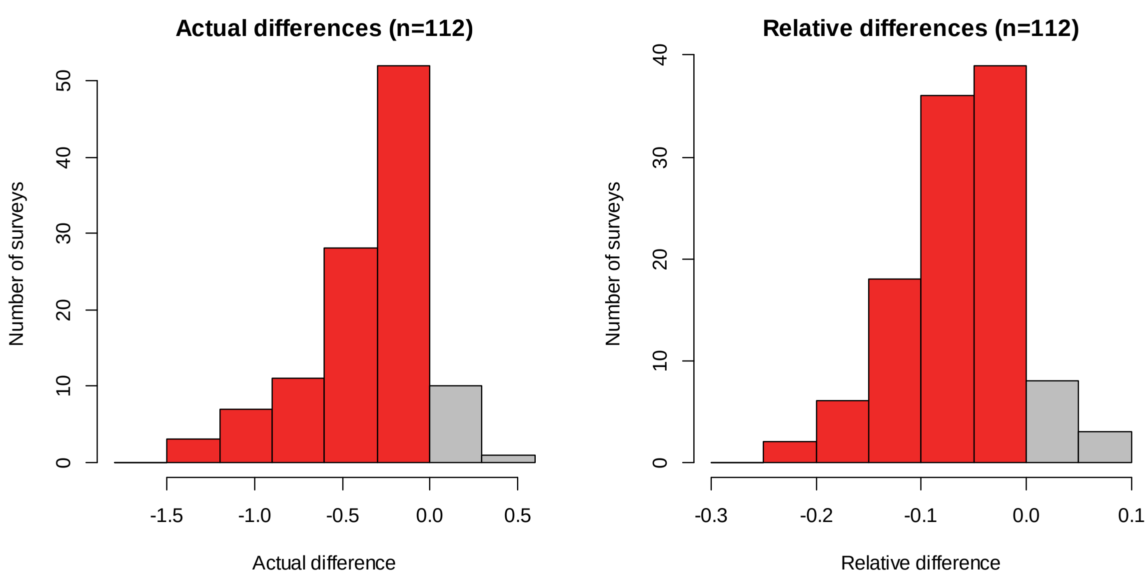
In this section, reconstructed, smoothed fertility trends are used as a reference for the comparison of published fertility rates. The procedure is as follows: for all surveys *except* the most recent survey in each country—i.e., 112 surveys in the 45 countries with more than one survey—the published estimate (red dot) is compared to the reconstructed smoothed estimate (black line).[11] Countries with only one survey are, by definition, excluded and the last survey is also excluded in all the countries. The difference between the published fertility rate and the reconstructed fertility rate is used as a metric of discrepancy across surveys. Although the reconstructed estimate is not the true value of the TFR it is expected to be closer (on average) to the true value than the published value estimated from a single survey.[12] It is important to emphasize that a published fertility lower than the reconstructed fertility may result from underestimation of the published TFR and/or overestimation of the reconstructed trend (and thus overestimation of fertility at the same period in subsequent surveys). As shown in Figure 3, when consistency across surveys is good, the published estimates will be close to the reconstructed estimate. When consistency across surveys is poor, as in Niger and Ethiopia, the published TFR can be much lower than the estimate from the reconstructed trend (Figure 3).

[11] The number of surveys should be 113 (182 surveys minus the most recent one in each of the 69 countries); and the number of countries with two surveys is 46. Since consistency of fertility trends cannot be analyzed in Brazil because the surveys do not cover the same geographic areas, only 112 surveys from 45 countries are used.

[12] The reconstructed estimate at one point in time is a weighted average of fertility estimated from different surveys.

Both the *actual difference* and the *relative difference* between the published and the reconstructed fertility estimates are computed.[13] Figure 4 shows the distribution of actual and relative differences in all the surveys. Overall, differences are negative in the large majority of surveys, showing a clear tendency of published TFRs to be lower than the estimates from the reconstructed trend. However, differences are moderate in most surveys. The average actual difference is -0.34 children and the relative difference is around -6 percent (Table 7). Half of the surveys have actual differences between 0 and -0.3 children and half of the surveys have relative differences of less than 5 percent. Yet, some surveys are characterized by large differences. In 26 surveys—out of 112 surveys from Phase 2 to Phase 5—published fertility is lower than reconstructed fertility by more than 10 percent and actual differences are greater than one child in seven surveys (Table 6). The 1990-1991 Pakistan survey and the 1999 Nigeria survey are especially problematic but surveys in Bangladesh, Ethiopia, Guinea, and India are also affected by serious problems. As expected, actual differences between published and reconstructed fertility increase with fertility levels (Figure 5); in contrast, relative differences do not vary with fertility levels.

Figure 4. Distribution of actual and relative differences between published estimates of TFRs (women 15-49, last three years) and estimates from reconstructed fertility trends (women 15-49, centered on the same date), 112 DHS surveys



[13] The actual difference is computed as ACT=TFR(p)-TFR(r), and the relative difference is REL=TFR(p)/TFR(r)-1, where TFR(p) is the published TFR for the three years preceding the survey and TFR(r) is the value from the smoothed reconstructed trend at the average date of the published TFR.

Figure 5. Relationship between published estimates of TFRs (women 15-49, last three years) and estimates from reconstructed fertility trends (women 15-49, centered on the same date), 112 DHS surveys

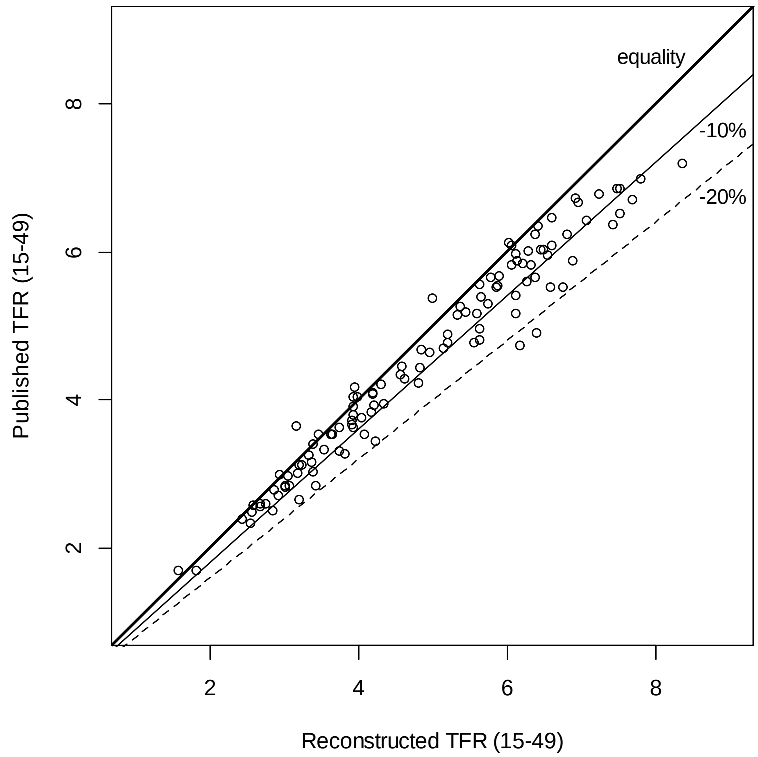


Table 6. Surveys in which the relative difference between the published TFR and the reconstructed TFR is greater than or equal to 10 percent, DHS surveys, 1991-2005

Country	Year	Relative difference	Actual difference
Bangladesh	1994	-0.18	-0.78
Bangladesh	1997	-0.14	-0.55
Bangladesh	2000	-0.12	-0.44
Bangladesh	2004	-0.11	-0.37
Benin	2001	-0.10	-0.65
Bolivia	1998	-0.12	-0.58
Burkina Faso	1993	-0.13	-1.00
Burkina Faso	2003	-0.14	-0.99
Cameroon	1998	-0.14	-0.82
Cameroon	2004	-0.12	-0.65
Chad	1997	-0.14	-1.05
Dominican Republic	1999	-0.17	-0.54
Ethiopia	2000	-0.18	-1.23
Ethiopia	2005	-0.11	-0.70
Guinea	1999	-0.16	-1.05
Haiti	1994	-0.14	-0.78
India	1999	-0.17	-0.59
Mali	1996	-0.13	-0.98
Mozambique	1997	-0.15	-0.94
Niger	1992	-0.10	-0.81
Niger	1998	-0.14	-1.16
Nigeria	1999	-0.23	-1.45
Nigeria	2003	-0.11	-0.71
Pakistan	1991	-0.23	-1.49
Peru	1992	-0.13	-0.52
Turkey	1993	-0.11	-0.33

Note: Shaded lines indicate surveys in which the relative difference is less than or equal to -0.15.

Table 7 shows the mean values of these indicators by region and DHS phase. The relative differences are highest in sub-Saharan Africa and Asia. Actual differences are highest in sub-Saharan Africa (-0.44 children), reflecting both the higher level of relative differences and the high level of fertility. Overall, differences increased slightly between DHS Phase 2 and Phase 3 (late 1990s) but have decreased since then. No estimate is available for Phase 6; estimates for Phase 5 suggest an improvement in the measurement of fertility, but the discrepancies may be underestimated.[14]

[14] The overall reconstructed trend may be pulled down by the latest observations, so that the difference in the next-to-last survey is underestimated.

Table 7. Mean of relative and actual differences between published estimates of TFR (15-49 years, last three years) and estimates from reconstructed fertility trends (15-49 years, centered on the same date), by region and DHS phase

	Relative difference			Actual difference			
	Mean	**Min**	**Max**	**Mean**	**Min**	**Max**	**N**
Region							
Sub-Saharan Africa	-6.8%	-23.4%	7.4%	-0.44	-1.45	0.37	58
Asia	-6.7%	-23.3%	3.1%	-0.27	-1.49	0.12	23
Europe	2.1%	-5.6%	9.8%	0.03	-0.10	0.15	2
Latin America	-6.3%	-16.9%	1.4%	-0.25	-0.79	0.04	19
MENA	-3.8%	-11.5%	1.1%	-0.14	-0.33	0.04	10
DHS Phase							
II	-5.2%	-23.2%	7.4%	-0.31	-1.49	0.37	20
III	-7.7%	-18.5%	-2.1%	-0.41	-1.16	-0.06	37
IV	-6.9%	-23.4%	6.3%	-0.36	-1.45	0.25	42
V	-1.9%	-11.5%	9.8%	-0.11	-0.70	0.15	13
Total	-6.3%	-23.4%	9.8%	-0.34	-1.49	0.37	112

3.3. Proximate Causes of Differences between Published and Reconstructed TFRs

The discrepancies between published TFRs and reconstructed TFRs may have several proximate causes, which were discussed in section 1.1.[15] Some recent births may have been displaced backward and some may have been omitted (Table 1). These two causes will lead to underestimating recent fertility. Another possible source of discrepancies is the "Potter effect"; in this case, retrospective estimates of fertility will be overestimated, pulling the reconstructed trend upward. Finally, differences in sample implementation across surveys may lead to higher or lower fertility than expected. While it is difficult to reach a definitive conclusion as to the causes of these discrepancies, it is possible to determine which are plausible, which are possible, and which to rule out. We first look at patterns of fertility around the cutoff year to identify general evidence of displacement and/or omission of recent births. Each cause is then examined more specifically in the next stage.

[15] Proximate causes refer to the types of data quality problems that cause these differences. Ultimate causes, e.g., design of questionnaire, education of interviewers, and interviewees, etc., are not discussed in this report.

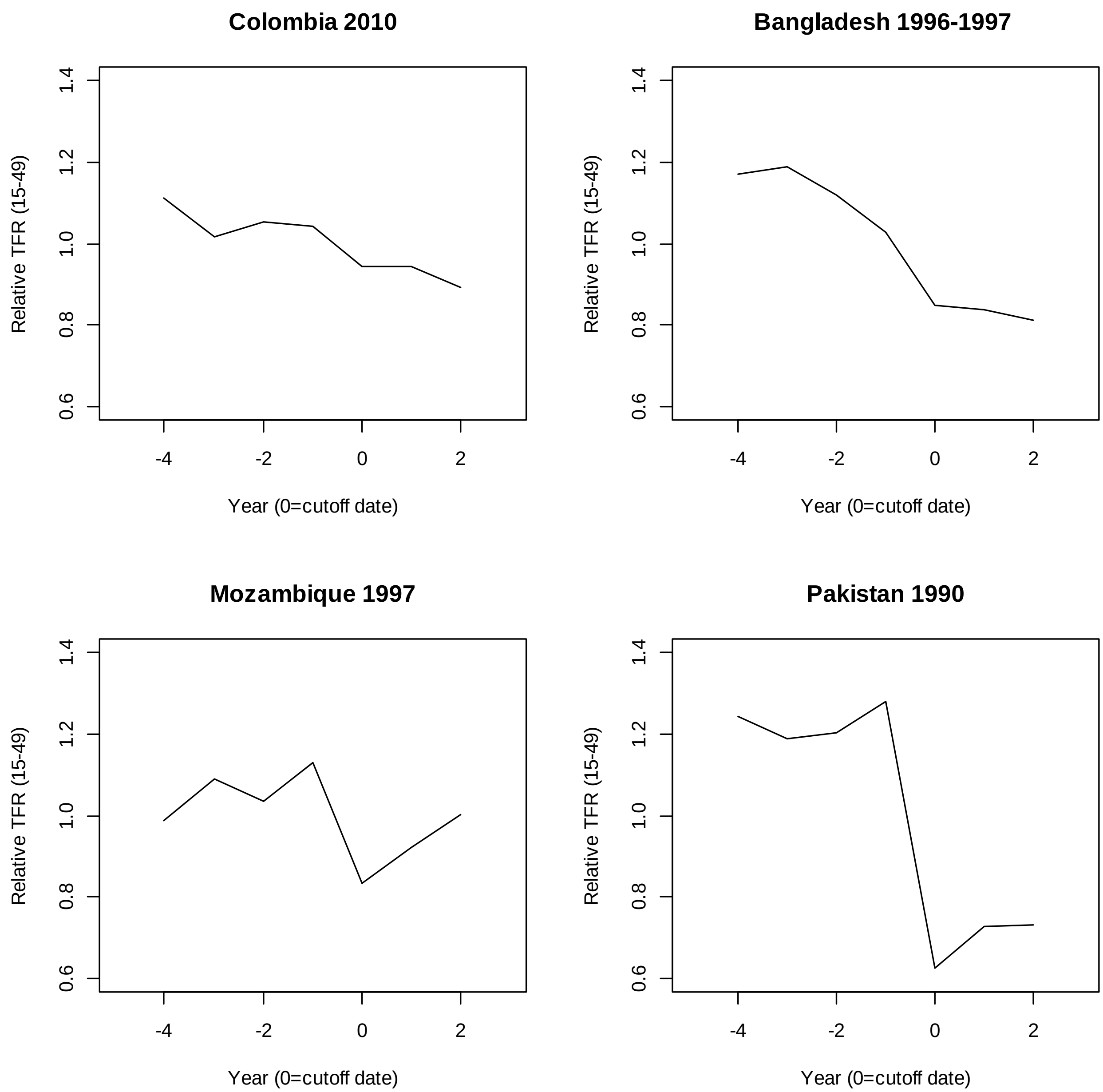
3.3.1. Patterns of fertility around the cutoff year of the health module

Patterns of fertility around the cutoff year for the child health section in the DHS questionnaire are useful as a first step in detecting displacement and omission of recent births. In each survey fertility rates are computed by single year for the four years preceding the cutoff date and the three years following the cutoff date.[16] This approach is similar to examining the distribution of births by calendar year (Marckwardt and Rutstein 1996); however, the evaluation of trends is facilitated with total fertility rates because exposure is controlled. In the absence of omission or displacement of births around the cutoff year for the child health section, we expect total fertility rates to vary in a regular way, i.e., with small fluctuations and no disruption in the fertility trend at the cut-off year. Displacement should cause an excess of fertility in the year before the cutoff date for the health section, reduced fertility in the first year covered by the health section, followed by a return to average fertility levels. In contrast, omission should cause a sudden drop in fertility at the cutoff year of the health section, with no recovery (Marckwardt and Rutstein 1996).

Relative total fertility rates (annual TFRs divided by the average TFR over the seven-year period—i.e., the four years preceding and the three years following the cutoff date of the birth history) are computed to compare patterns across surveys. Figure 6 illustrates four cases that show distorted fertility patterns based on the relative TFR data from Colombia, Bangladesh, Mozambique, and Pakistan. In all four surveys, there is a more rapid drop in fertility between the year just before the cutoff date (year 1) and the first year covered by the health section (year 0). The distortion in the fertility trend is small in Colombia and moderate in Bangladesh. In these two countries some displacement of births is likely but it is difficult to conclude anything about underreporting of births. In contrast, the sharp drop in Pakistan—fertility decreases by 50 percent in one year—that was not followed by a recovery, suggests births were underreported (Marckwardt and Rutstein 1996). In Mozambique underreporting of births is also possible, but the pattern is less obvious than in Pakistan.

[16] Three years were used because the cutoff date was three years before the survey in a few cases (e.g., Ghana 1998, Kenya 1998).

Figure 6. Patterns of relative TFRs around the cutoff year of the child health section in the DHS questionnaire, DHS surveys in Colombia (2010), Bangladesh (1996-97), Mozambique (1997), and Pakistan (1990)



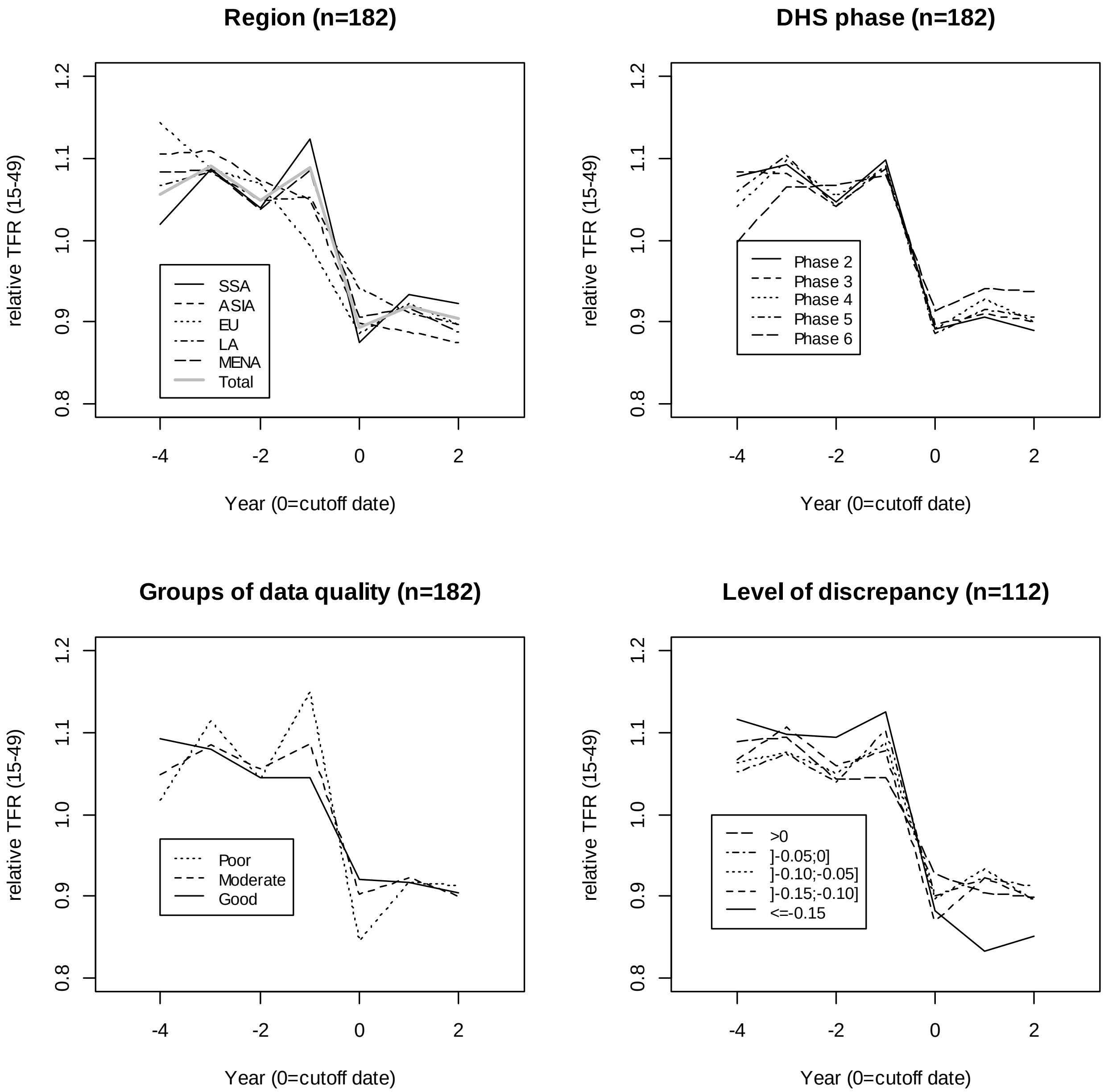
Fertility trends and patterns of relative TFRs around the cutoff year were computed for the 182 surveys; average patterns for several groups of surveys (regions, phase, data quality groups, differences between published and reconstructed fertility) are shown in Figure 7. On average, the relative fertility level drops from 1.08 just before the cutoff year to 0.90 in the first year covered by the child health section, and remains at that level for three years. This pattern shows that the cutoff year for the child health section is associated with serious distortions in fertility levels and trends. In sub-Saharan Africa the highly distorted pattern is consistent with both displacement and omission of births. In the other regions evidence is less conclusive. The pattern in the MENA countries is also highly distorted, but this is largely because of Yemen. In Asia and Latin America the average patterns are less distorted than those in the previous two regions. Birth histories in the European surveys are least affected by the cutoff date. Comparisons of average patterns by DHS phase also indicate that this pattern of fertility is an enduring characteristic of the DHS surveys (Figure 7).

Further analysis is done using two other classifications. First, average patterns are computed for the three groups of countries categorized in Table 5 by subjective evaluation of data quality (182 surveys). The *poor quality* group comprises 18 countries where consistency of fertility trends across surveys is low or—when only a single survey is available—where the trend is very irregular. The *high quality* group comprises 26 countries, and the *moderate quality* group consists of 25 countries. As expected, patterns are much more distorted in countries with poor data quality, and this pattern is compatible with both displacement and omission of births. Patterns are less distorted in the countries with good data quality; there may be some omission, but this could be due to moderate displacement and reflect the overall fertility trend. The pattern is intermediate in countries with moderate data quality; omission of births is possible, but this pattern could result from displacement and decreasing fertility.

Patterns are also compared across five groups of surveys based on the difference between published fertility and reconstructed fertility (112 surveys, Figure 7). In the least favorable group—which has the greatest amount of discrepancy—published fertility is lower than reconstructed fertility by at least 15 percent (eight surveys, Table 6). In the most favorable group—which has the least amount of discrepancy—published fertility is greater than or equal to reconstructed fertility. Again, distortions are most severe in surveys where differences between published and reconstructed TFRs are large. In the least favorable group, fertility in the three years following the cutoff year is well below fertility in the four years preceding the cutoff year (by more than 20 percent); this pattern suggests serious omission of births in these surveys. In countries with smaller discrepancies the pattern is also distorted but, again, this could result from displacement and reflect the overall fertility trend.

In summary, the patterns of fertility around the cutoff year for the child health section in the DHS questionnaire indicate that the reporting of births has had an impact on DHS fertility rates. Countries where fertility trends are less consistent or less regular show more distorted patterns of fertility around the cutoff year. The distortion is also greater for surveys in which published fertility is much lower than reconstructed fertility, indicating these two problems—distortions in fertility trend and difference between published fertility and reconstructed fertility—are related.

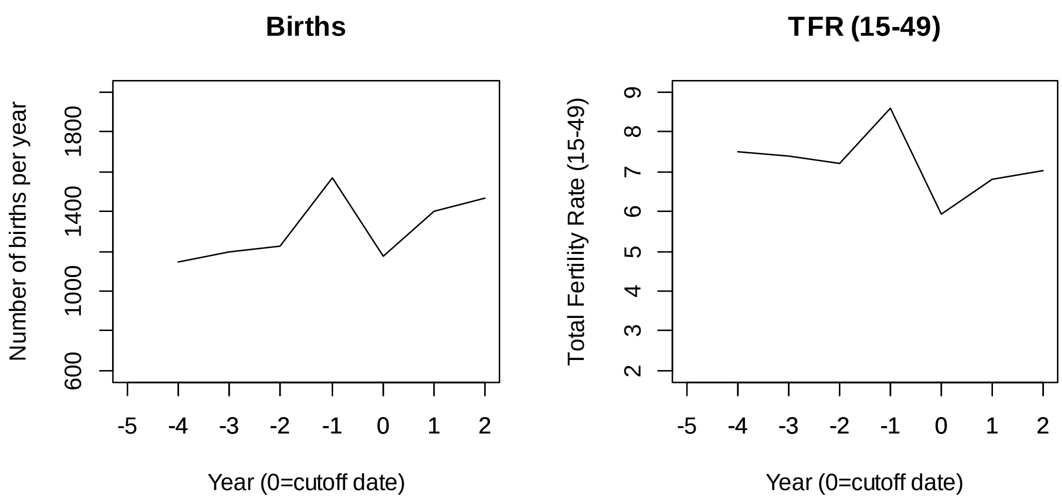
Figure 7. Average patterns of relative TFRs around the cutoff year of the child health section in the DHS questionnaire, by region, by phase, by groups of data quality, and by level of discrepancy between published and reconstructed TFRs



3.3.2. Does displacement of recent births account for the difference between published and reconstructed fertility estimates?

We now look at evaluating the extent of displacement of recent births and the potential impact of displacement on the difference between published and reconstructed fertility estimates. The measurement of displacement of births is based on the distribution of births by calendar years (the cutoff date for the child health section in the DHS questionnaire usually corresponds to the beginning of a calendar year). Using the 1995 Uganda DHS as an example, Figure 8 shows the distribution of births by calendar year around the cutoff date for the child health section in the questionnaire. The number of births in the first year covered by the health section (year 0) appears exceptionally low compared with the year preceding the cutoff date (year -1). There was a decrease from 1,567 births in year -1 to 1,174 births in year 0. This pattern is mirrored by a strong decrease in the TFR between year -1 (8.6 children) and year 0 (6.0 children).

Figure 8. Distribution of births and total fertility rates (TFRs) by single years around the cutoff date for the child health section in the DHS questionnaire, Uganda 1995



An index of displacement of births from year 0 (cutoff year) to year -1 (year preceding cutoff) is computed using the same method as Pullum (2006). The expected numbers of births in year 0 ($\hat{c}$) and in year -1 ($\hat{b}$) are estimated in the following way:

$$\hat{b} = (b + c).\frac{1}{1+\left(\frac{d}{a}\right)^{1/3}} \qquad (1)$$

$$\hat{c} = (b + c).\frac{\left(\frac{d}{a}\right)^{1/3}}{1+\left(\frac{d}{a}\right)^{1/3}} \qquad (2)$$

Where *a* is the number of births in year -2, *b* is the number of births in year -1, *c* is the number of births in year 0, and *d* is the number of births in year 1. The number of displaced births (*DB*) is obtained as follows:

$$DB = b - \hat{b} = \hat{c} - c \qquad (3)$$

The displacement index (interpreted as a percentage of births displaced from year 0 to year -1) is computed as follows:

$$DISPL = \frac{\hat{c} - c}{\hat{c}} \qquad (4)$$

Displacement of births appears to be common. The displacement index is positive in seven out of eight surveys, and is above 10 percent in three out of ten surveys (Figure 9). Overall, displacement is most severe in sub-Saharan Africa (Table 8), a finding that is consistent with previous analyses of DHS data quality (Arnold 1990; Marckwardt and Rutstein 1996; Pullum 2006). In contrast, displacement is less pronounced in Latin America and in the European surveys. No clear trend in displacement is visible across DHS phases.

Figure 9. Distribution of the displacement index in 182 DHS surveys

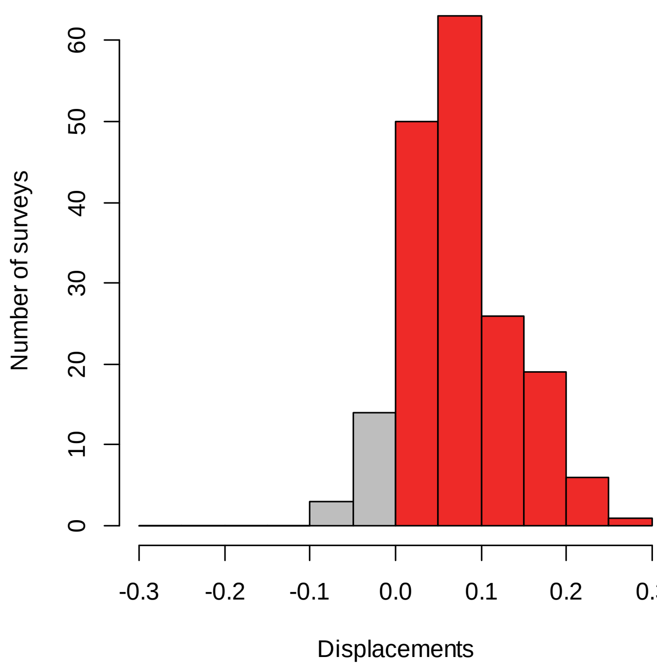


Table 8. Average index of displacement of births around the cutoff year for birth histories in the DHS questionnaire, by region and by phase, 182 DHS surveys

	Mean	Min	Max	N
Region				
Sub-Saharan Africa	10.0%	-9.3%	25.1%	93
Asia	5.4%	-4.1%	25.0%	36
Europe	2.8%	-2.0%	8.1%	7
Latin America	3.7%	-6.6%	13.0%	31
MENA	6.7%	-0.4%	15.2%	15
DHS Phase				
II	7.5%	-0.6%	25.0%	23
III	7.6%	-6.4%	23.4%	45
IV	7.0%	-6.6%	22.3%	48
V	8.4%	-2.0%	25.1%	43
VI	6.3%	-9.3%	16.9%	23
Total	7.5%	-9.3%	25.1%	182

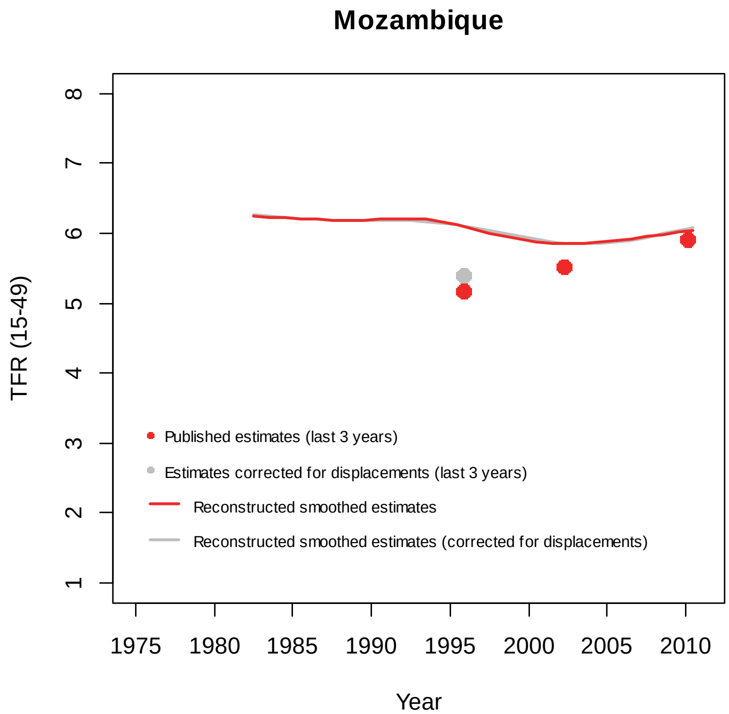
Although displacement is widespread and sometimes severe, several factors indicate that the discrepancies between published TFRs and reconstructed TFRs described in section 3.2 do not result from the displacement of births. First, the published TFRs are computed over the three years preceding the survey, whereas the reference period for the child health section is more than five years in most surveys (Figure 2). Even if respondents or interviewers displace dates of recent births by two years, this will have no effect (or a very limited effect) on recent fertility. In surveys with shorter reference periods, as in DHS Phase 3 (Table 4), displacement may potentially have greater influence.[17]

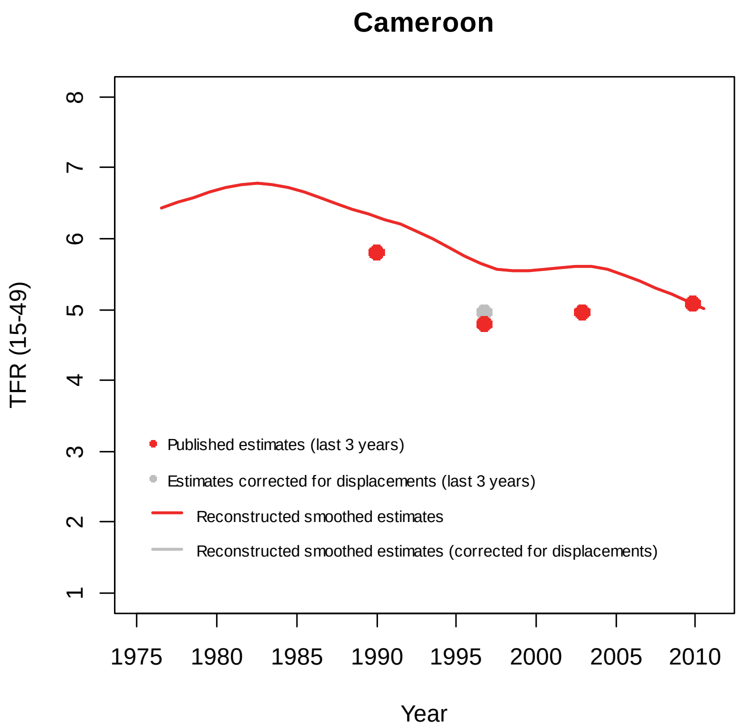
To evaluate the impact of displacement on the measurement of fertility, births were displaced in the birth histories to obtain the corrected distribution of births around the cutoff year estimated using equation (1) and equation (2). This correction was done for each age group separately.[18] Total fertility rates over the last three years are then computed after correcting for birth displacements in all 182 DHS surveys. As expected, displacement of births has no effect on the TFR in surveys with a long reference period for the child health section (5 or more years) and has a very limited effect in most surveys with a short reference period. In only six surveys does displacement have an impact on the TFR greater than 2 percent, and the impact is greater than 3 percent in just two surveys (Mozambique 1997 and Cameroon 1998). Reconstructed fertility trends with pooled birth histories were computed using the corrected birth histories; fertility trends are virtually identical to trends obtained with the original data (examples from Mozambique and Cameroon, Figure 10).

[17] In such cases, the TFRs published in the country reports often refer to the five years before the survey so that displacement of births should have limited impact. However, published TFRs on the DHS STATcompiler are computed for a three-year period and may be affected.

[18] In practice, the percentage of births to displace back (DISPL) was computed using equation (4) in each five-year age group. A random sample (with a sampling rate equal to DISPL) of births that had occurred in the cutoff year was selected, and 12 months were removed from these dates of birth.

Figure 10. Reconstructed fertility trends and fertility for the last three years with and without correcting for displacement of births, DHS surveys in Mozambique and Cameroon

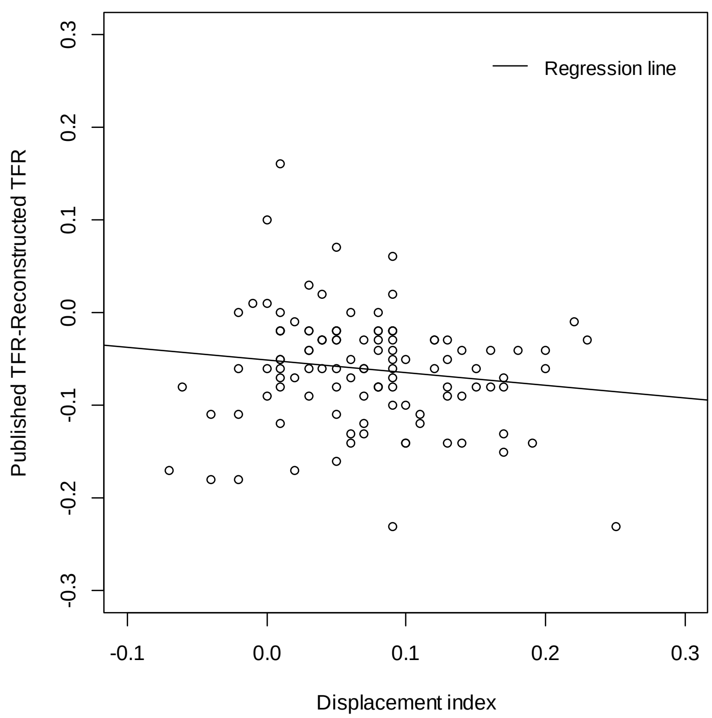




Legend: Red dots represent TFRs for the three years preceding the surveys with the original data (published TFRs). Grey dots are TFRs for the three years preceding the surveys with date of birth corrected for displacement. The red line is the reconstructed fertility trend with the original data. The grey line is the reconstructed trend with date of birth corrected for displacement. The red line and the grey line are almost impossible to distinguish.

A further indication of the limited role of birth displacement on the discrepancy between published fertility and reconstructed fertility is the weak correlation between the index of displacement of births and the difference between published and reconstructed fertility (r=-0.14); the correlation is too weak for displacement to be a major explanation of the discrepancies. In summary, displacement is widespread but has limited impact on the measurement of recent fertility and cannot account for differences between published fertility and reconstructed fertility. Other factors must explain the differences.

Figure 11. Correlation between displacement of births in 112 DHS surveys and relative difference between published and reconstructed TFRs (r=0.14)

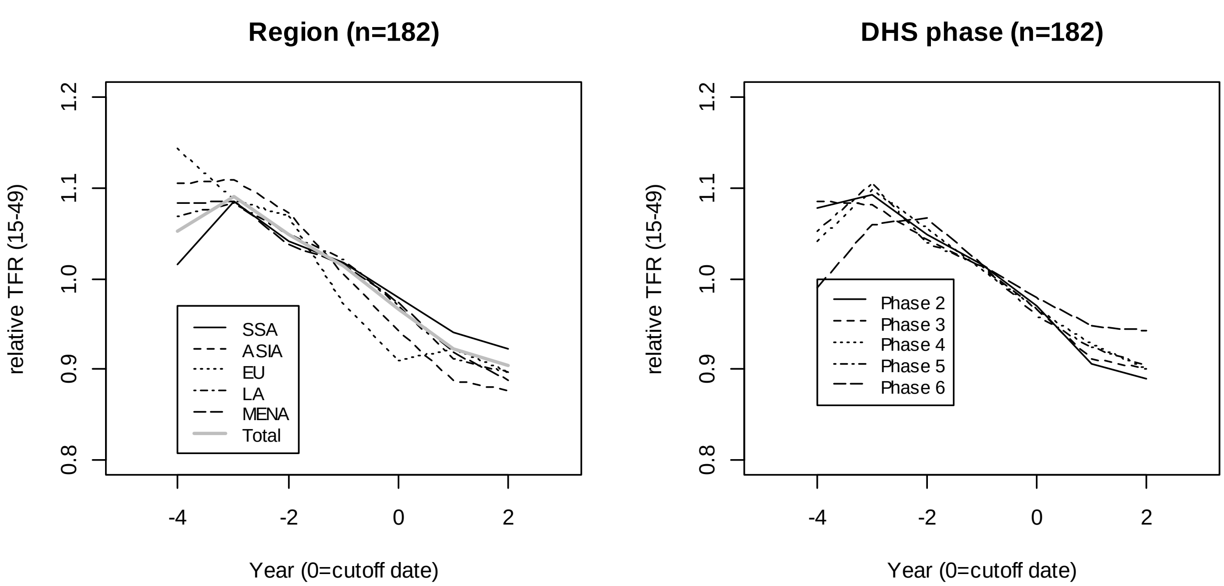


3.3.3. Is there evidence of omission of recent births?

Because displacement of recent births cannot account for discrepancies between published and reconstructed fertility, underreporting of births becomes a serious candidate. Two approaches are used in this study to evaluate possible omission of recent births.

The first approach looks at patterns of fertility around the cutoff year after correcting for displacement of births. As in section 3.4.1, average patterns were computed for all the surveys by region, by phase, by groups based on subjective evaluation of data quality, and by groups based on differences between published and reconstructed fertility. The average patterns look much more regular than the original patterns and do not differ substantially across categories of countries or surveys (Figure 12). There is one notable exception however: in the eight surveys for which the difference between published fertility and reconstructed fertility is large (>15 percent),[19] the decrease in fertility is very steep and the pattern remains clearly distorted after correcting for displacement. Both the difference between published fertility and reconstructed fertility and the distorted patterns of fertility suggest underreporting of births is likely in these surveys. However, this method is not sufficient to rule out underreporting of recent births in surveys with more regular patterns. First, the correction for displacement may in fact "overcorrect" displacement of births, and the reconstructed trend may be more regular than it actually is. Second, a regular downward trend in one survey may turn out to be much lower than the reconstructed trend with pooled surveys.

Figure 12. Average patterns of relative TFRs around the cutoff year of the child health section in the DHS questionnaire, by region, by phase, by groups of data quality, and by level of discrepancy between published and reconstructed TFRs (birth histories corrected for displacement of births)



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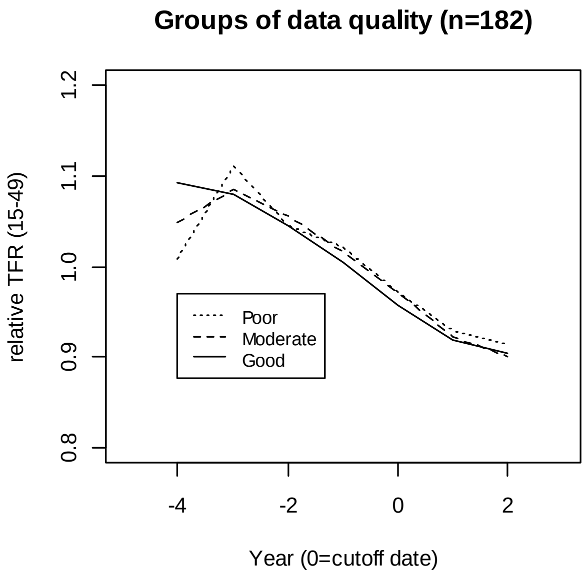
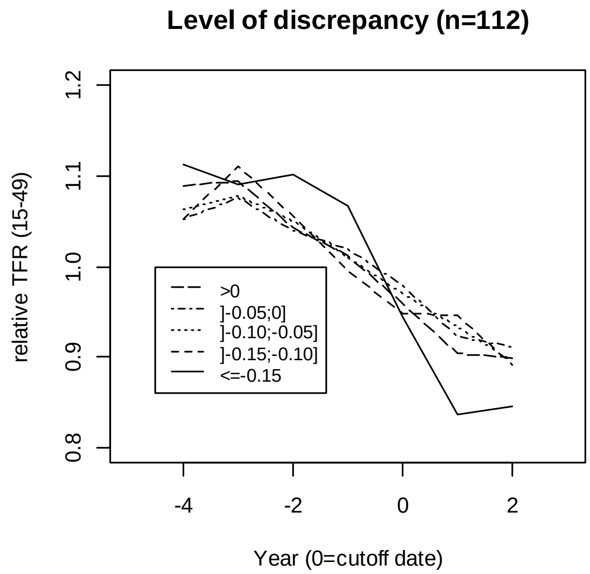
[19] Bangladesh 1994, Dominican Republic 1999, Ethiopia 2005, Guinea 1999, India 1999, Mozambique 1997, Nigeria 1999, and Pakistan 1990-91.

Figure 12. – *Continued*





The second approach to evaluating possible omission of recent births looks at the consistency of reconstructed fertility trends after correcting for other types of problems. In the previous step, birth displacement was corrected. Trends were reconstructed in the 69 countries for each survey, separately by three-year periods (Appendix Figure A2); three-year periods provide a clearer picture of differences across surveys. Because displacement is accounted for, the remaining differences between the reconstructed trends and the recent TFRs (red dots) are due to other factors. Omission of births is one of these factors; it is expected to be reflected in a sharp drop of the TFR in the last or two last three-year periods. Fertility is expected to be lower than fertility at the same period in subsequent surveys, while estimates from different surveys should match in periods not influenced by omission of recent births.

Six cases are illustrated in Figure 13; the six countries—Bangladesh, Burkina Faso, Cameroon, Ethiopia, Haiti, and Niger—all include at least one survey for which the difference between the published fertility and the reconstructed fertility was greater than 10 percent (Table 6). The evaluation is essentially qualitative and is based on visual inspection of reconstructed fertility trends. In Bangladesh, Burkina Faso, Cameroon, Ethiopia, and Niger the patterns are suggestive of omission of recent births in all or several surveys. In Haiti, fertility trends for the three most recent surveys match quite well, but estimates from the first survey are well below the other estimates, and the drop in the TFR a few years before the survey could reflect omission of births. Among the 45 countries with at least two surveys, 26 countries[20] show at least one survey with inconsistencies that are characteristic of omission of births (Appendix Figure A2). Among the 26 surveys in Table 6, underreporting of recent births appears as plausible in most of the countries, and possible in all of them. However, some inconsistencies may also be due to at least two other factors: differences in sample composition and Potter effect.

[20] They correspond to a large extent to the countries in the *poor* and *moderate* data quality categories of Table 5.

Figure 13. Reconstructed fertility trends (TFR 15-49) in six countries by three-year periods preceding each survey, fertility for the last three years, and reconstructed fertility with pooled birth histories (birth histories corrected for birth displacement)

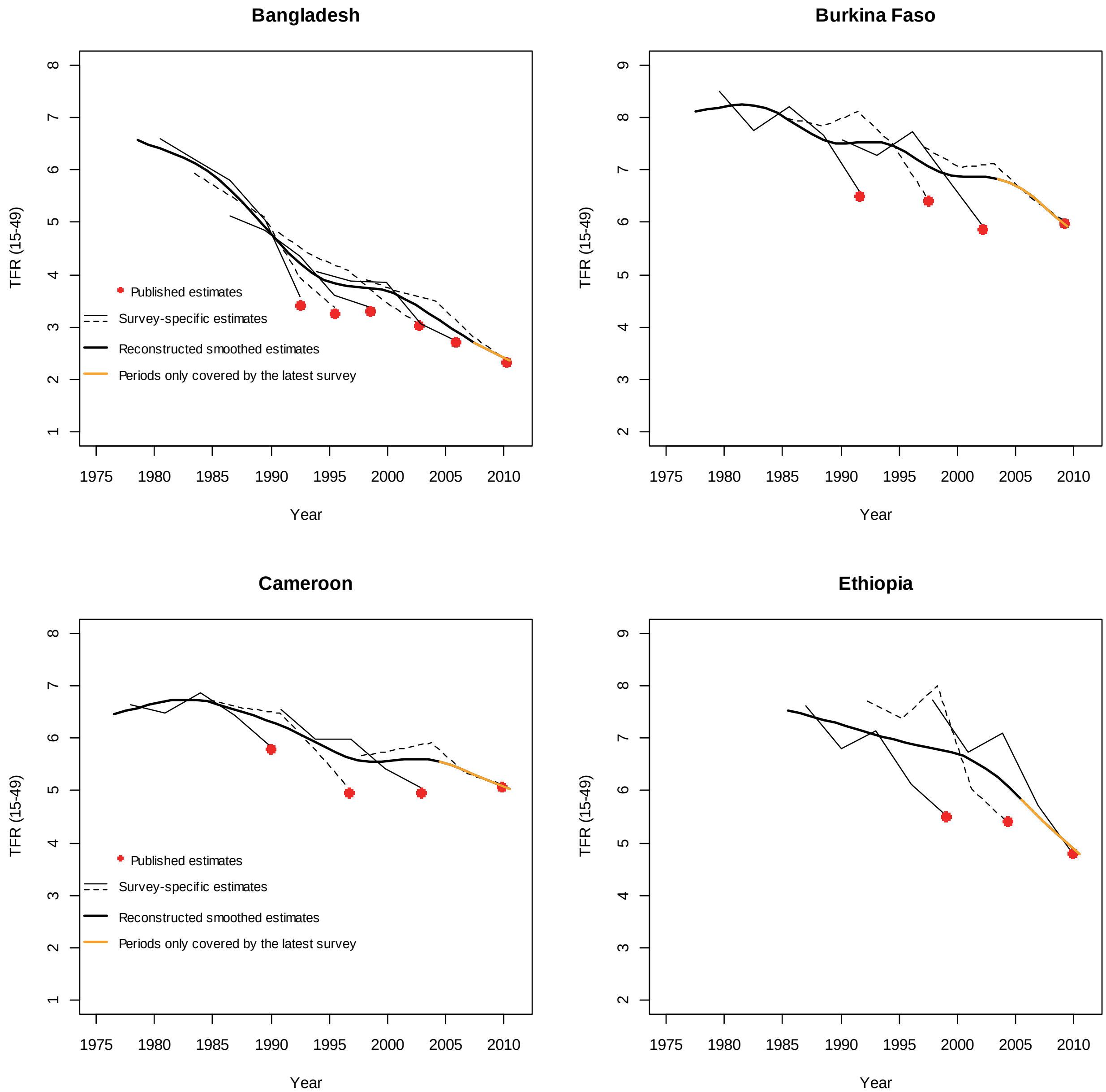


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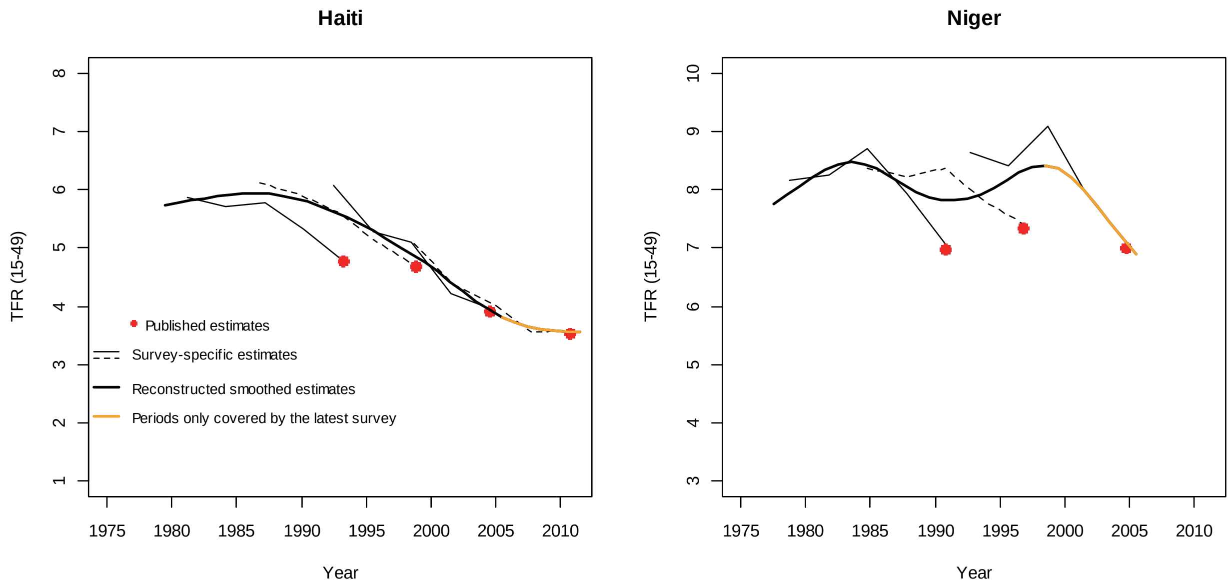
Figure 13. – *Continued*



3.3.4. Are these differences compatible with a Potter effect?

A further step consists of evaluating if the differences between published and reconstructed trends may be due to a Potter effect (Moultrie 2013; Potter 1977). According to the Potter effect, first births tend to be erroneously reported at higher ages (i.e., older ages and later dates). As a result, if all the births are reported, birth intervals will be shorter than they actually are and fertility trends will be distorted. In this case, discrepancies between reconstructed fertility rates would not stem from underestimation of recent fertility but from overestimation of fertility in the intermediate periods that pulls the reconstructed trend upward.

The approach used here consists of evaluating if the observed discrepancies are *compatible* with a Potter effect. Two steps are applied in this approach. First, fertility rates are reconstructed over a long period (30 years) for young age groups (women 15-24) to evaluate the possibility of a Potter effect. In the presence of a Potter effect, fertility (15-24) should increase in the past, because of the underestimation of fertility at young ages. The second step consists of manipulating the birth histories to “correct” for a possible Potter effect. The total number of births for each woman is left unchanged, but the dates of birth are changed so that the births are spread over a longer period of time. The duration between each birth and the cutoff year is increased by a factor of 10 percent.[21] This correction (10 percent) was set arbitrarily but is a plausible upper limit for a Potter effect. It corresponds roughly to a median age at first birth that is around 2.5 years lower in the oldest cohort than when the Potter effect is not corrected.[22] This is a crude approach because it considers that the same factor is applicable to all surveys. A further step would be to evaluate more

[21] Only dates of births before the cutoff year of the birth history in the DHS questionnaire are changed because it is expected in the Potter effect that dates of recent births are reported accurately. Corrections for displacement of births described earlier are also taken into account.

[22] For instance, correcting for the Potter effect in Burkina Faso (2003) leads to a median age at first birth of 17.5 years among women 45-49, compared with 19.75 years without correcting for the Potter effect. In the 2004 DHS in Cameroon, this correction leads to a median age at first birth of 16.4 years instead of 18.8 years.

precisely the extent of the Potter effect for each survey and correct fertility trends accordingly. This process is beyond the scope of this report. The objective here is to evaluate 1) if a Potter effect is a possible source of discrepancy, and 2) if discrepancies between published and reconstructed fertility are still visible after correcting for the upper value of the Potter effect. Remaining discrepancies, after correcting for a Potter effect, point to other sources of errors such as omission of births and differences in sample composition.

The six countries shown in Figure 13 are used again in Figure 14 to illustrate this method; Ghana is also added as a contrasting example. Trends in (partial) total fertility rates (15-24) for the 30 years preceding the surveys (by three-year periods) are reconstructed using the same method as that used for the total fertility rate (15-49). Restricting the analysis to young women allows for both reconstructing fertility over a long period and identifying unusual fertility trends at early ages. In Figure 14, successive surveys from the same country are shown on dual figures; the figure on the left shows partial TFRs based on birth histories that were not corrected for the Potter effect; the figure on the right shows the partial TFRs with corrected birth histories. It can be seen from these figures that correcting for the Potter effect has a strong influence on fertility trends and, as a result, on the consistency of fertility estimates across surveys.

In Burkina Faso, Cameroon, Haiti, and Niger the trends in fertility (15-24) show an increasing trend in the past, consistent with a Potter effect. In Bangladesh and Ethiopia the trend is less defined. Interestingly, when correcting for a Potter effect, consistency across surveys improves substantially in Burkina Faso, Cameroon, and Niger as well as in Bangladesh. In Haiti, estimates from the last three surveys are closer to each other after correcting for the Potter effect, but fertility in the first survey is lower, reflecting possible differences in sample composition discussed earlier. In Ethiopia, consistency is not improved by correcting for a Potter effect. The Ghana example illustrates a similar situation; no Potter effect is visible and “correcting” for it causes deterioration in consistency across surveys. Results are available in Appendix Figure A3 for the 18 countries where large discrepancies were found in 26 surveys. In most countries Potter effects are possible (Table 9); in only a few do they lead to deterioration in consistency across surveys.[23]

[23] These results only indicate that Potter effects are possible, not that they are plausible. Decreasing trends in median age at first birth by cohorts of women (not shown) suggest Potter effects are the more plausible in Burkina Faso, Mali, Niger, Guinea, and Mozambique.

Figure 14. Reconstructed fertility at young ages (TFR 15-24) in six countries by three-year periods preceding each survey, with and without correcting for a possible Potter effect (10 percent increase of birth intervals)

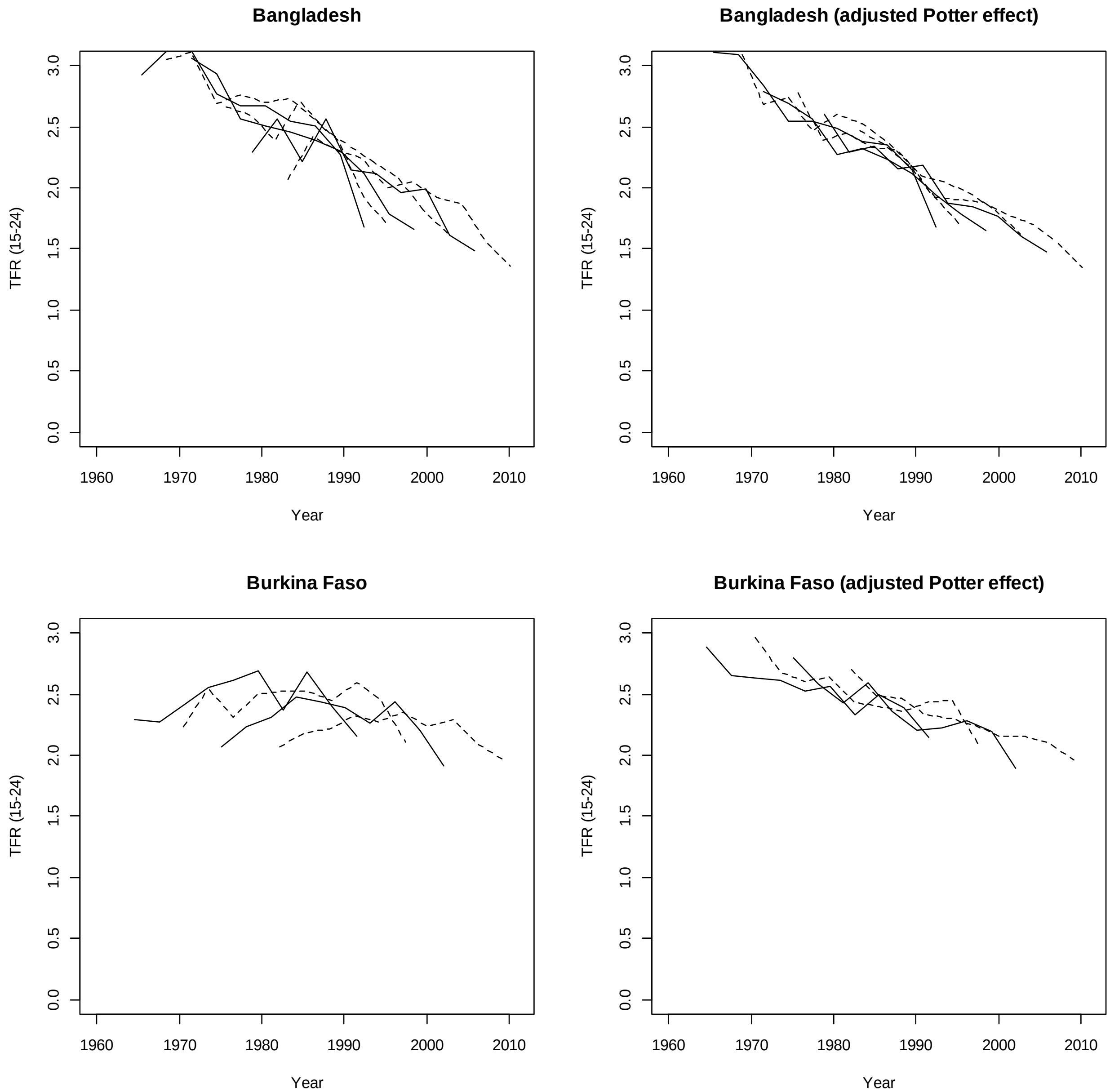


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Figure 14. – *Continued*

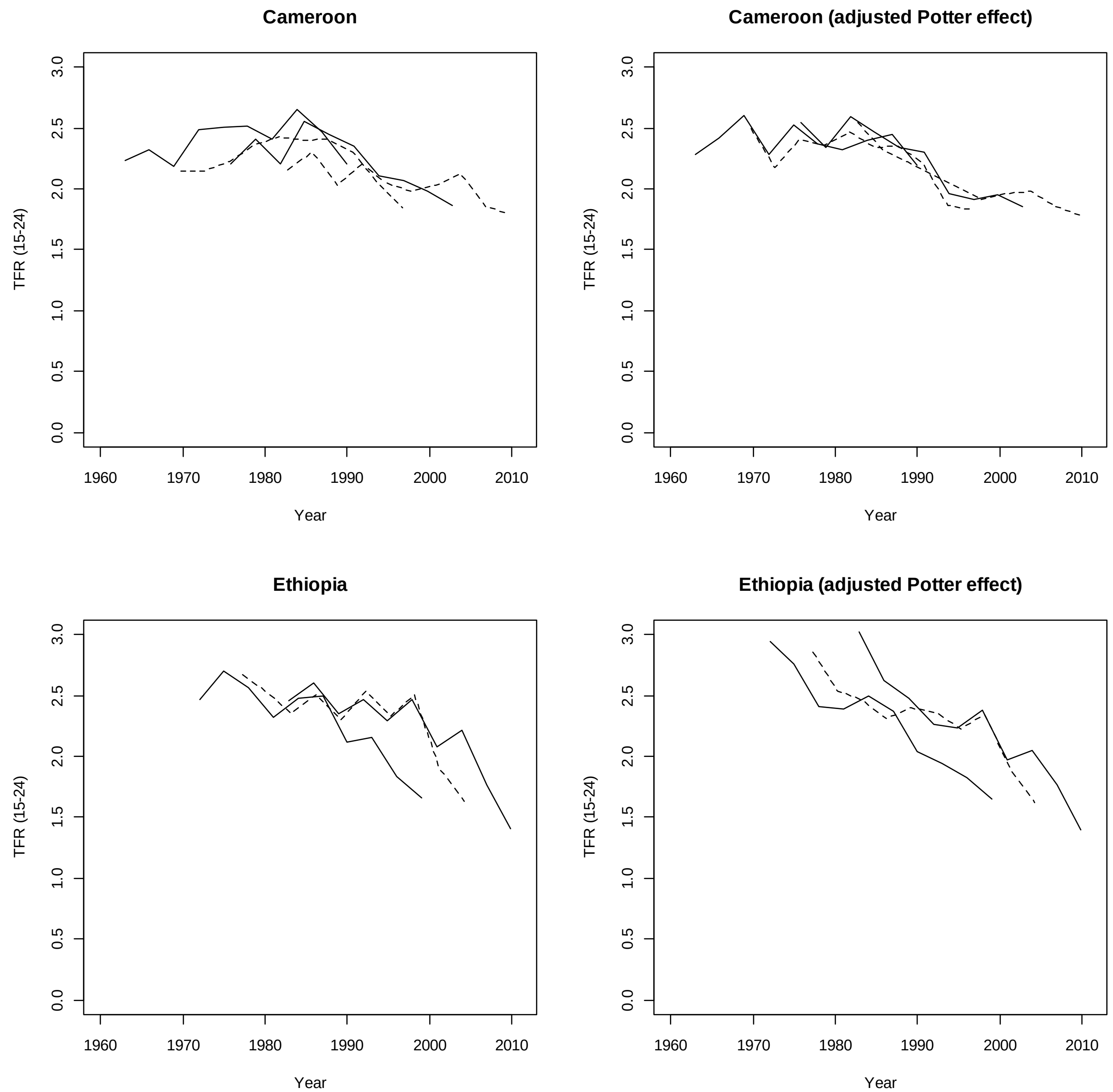

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Figure 14. – *Continued*

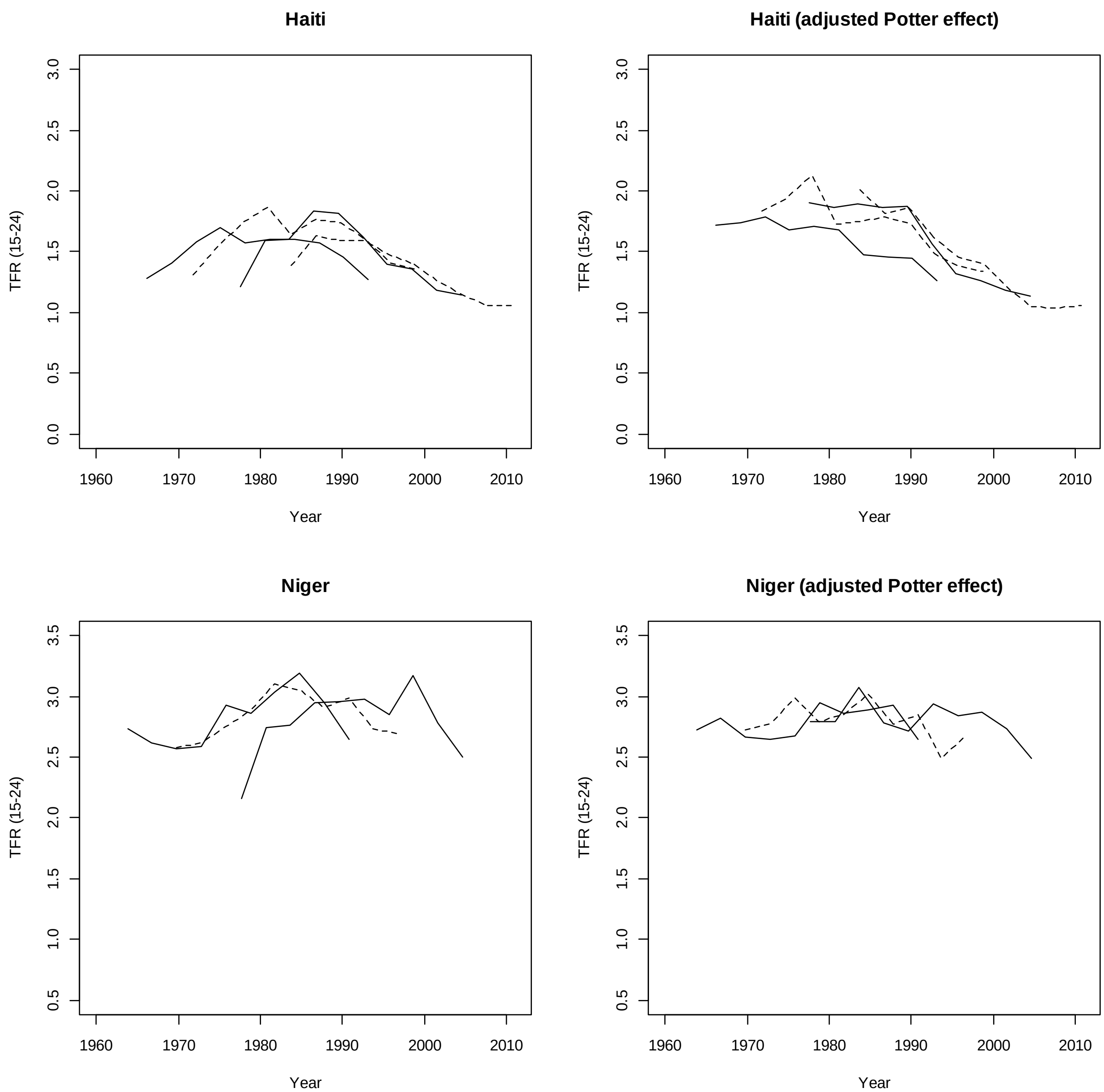

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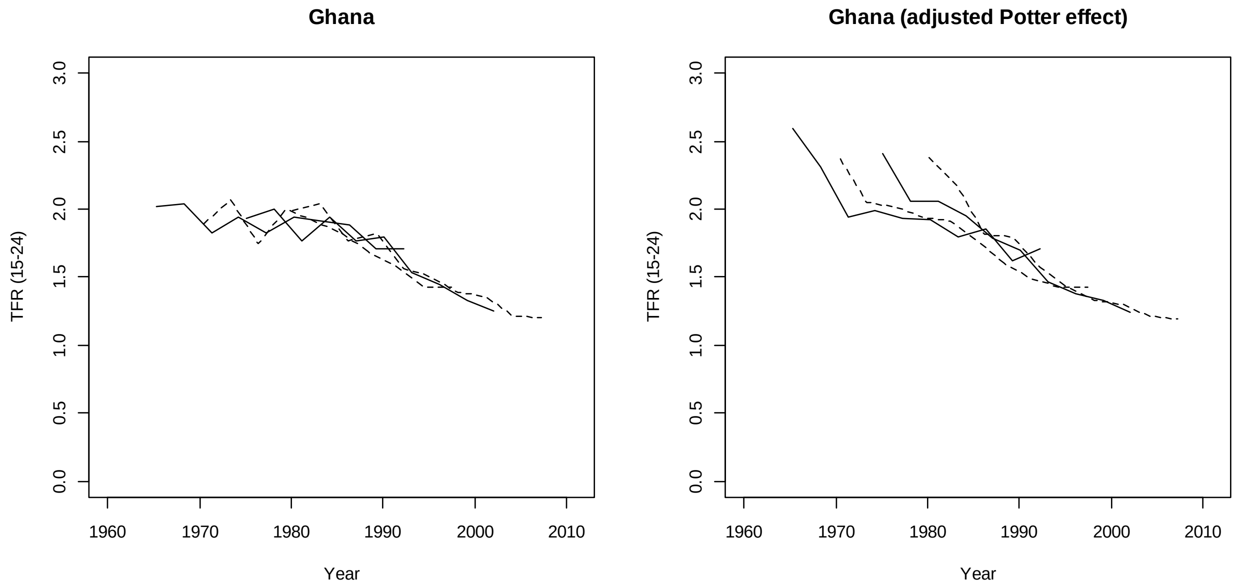
Figure 14. – *Continued*

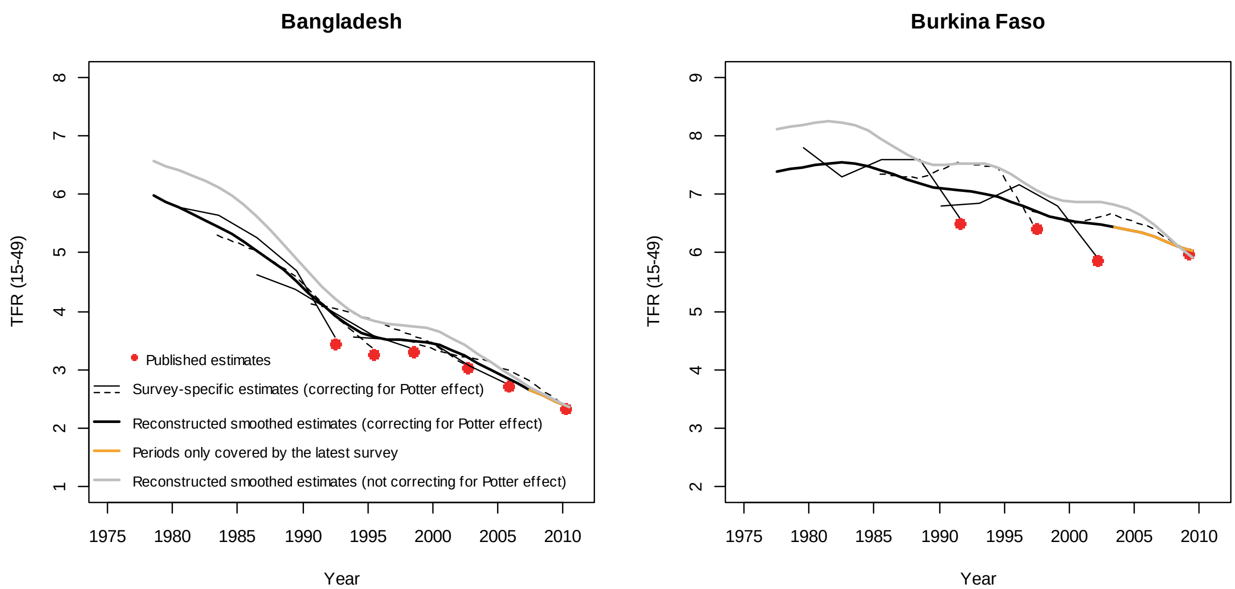


The second step in evaluating if observed discrepancies are *compatible* with a Potter effect consists of reconstructing fertility trends (TFR 15-49) using birth histories that are corrected for the upper value of the Potter effect. The approach we follow here consists of "correcting" all the birth histories for a Potter effect to the same extent, regardless of the plausibility of the Potter effect. This allows measuring residual discrepancies between published and reconstructed estimates in a worst case scenario for Potter effects. Figure 15 shows the results for the same six countries. The corrected reconstructed trend (black thick line) is now much closer to the published estimates (red dots) than the reconstructed estimates not correcting for the Potter effect (grey thick line). These new estimates suggest that the Potter effect affects the reconstruction of fertility estimates and that accounting for this possibility is important when explaining discrepancies between published and reconstructed estimates. In Bangladesh and Haiti, estimates are now much closer; improvements are also seen in Burkina Faso, Cameroon, and Niger,[24] although discrepancies persist for a number of surveys. In Burkina Faso, for example, published estimates from the first and third surveys are still below the reconstructed trend. This difference and the sharp decrease in fertility in the last three years are consistent with omission of recent births.

[24] Discrepancies are also reduced in Ethiopia, even though evidence of a Potter effect was not found in fertility at young ages. This illustrates that a better agreement between fertility for the three years preceding the survey and reconstructed fertility should not be interpreted as evidence of a Potter effect.

Appendix Figure A4 shows the results for the 18 countries, including the 26 surveys in Table 6. In most countries consistency between the reconstructed fertility trends and published fertility is improved, indicating that Potter effects may be part of the explanation for the discrepancies. However, in all 26 surveys, correcting for a Potter effect leaves clear differences between published estimates and reconstructed estimates, and in half of the surveys, the difference is below -8 percent (Table 9). One may consider these residual differences as lower estimates,[25] and omission of recent births thus appears as a plausible explanation for these differences in most of the 26 surveys. In a few cases, sample implementation is also a possible explanation.

Figure 15. Reconstructed fertility trends (TFR 15-49) in six countries by three-year periods preceding each survey, fertility for the last three years, and reconstructed fertility with pooled birth histories with (black thick line) and without (grey thick line) correction for the Potter effect



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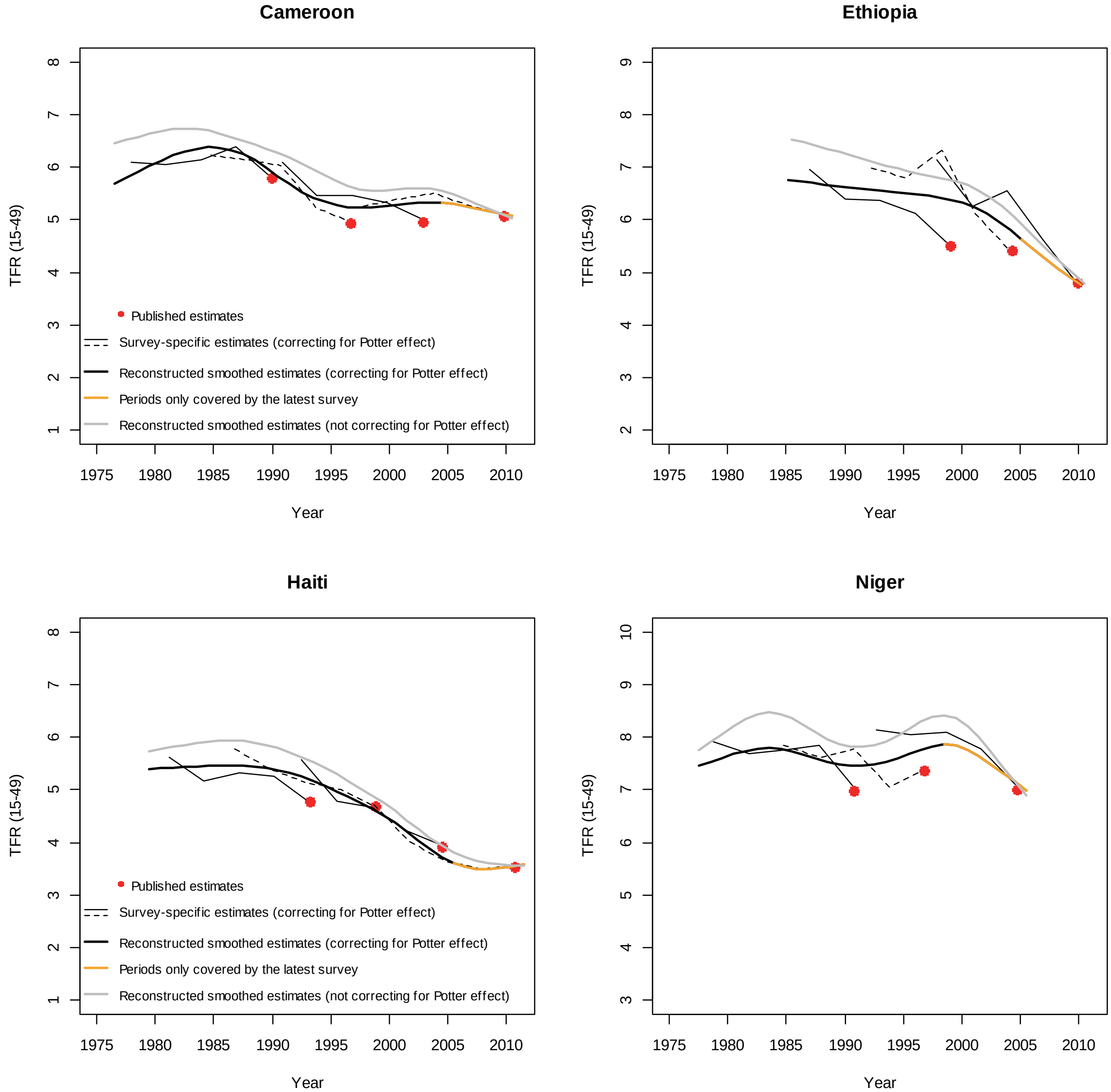
[25] First, an upper value of the Potter effect was used for the correction; with a smaller correction of the Potter effect, residual differences would be larger. Second, the reconstructed trend falls between published fertility and the estimate of fertility at the same time in subsequent survey. In this way, the reconstructed fertility trends already corrects partly for omission of recent births.

Figure 15. – *Continued*



Legend: The black line represents the smoothed fertility trend correcting for a possible Potter effect. Retrospective estimates from each survey also correct for the Potter effect. The thick grey line is the smoothed fertility trend based on the data only correcting for displacement.

Table 9. Evaluation of proximate causes of discrepancies between published fertility and reconstructed fertility in 26 DHS surveys, 1991-2005

Country	Year	Relative difference (1)	Displacements (2)	Omission after correcting for displacements (3)	Potter effect (4)	Residual relative difference (5)	Impact of sample implementation (6)	Omission of recent births, after considering other errors (7)
Bangladesh	1994	-0.18	No	Yes	Possible	-0.13	Slight	Strong
Bangladesh	1997	-0.14	No	Yes	Possible	-0.08	Slight	Moderate
Bangladesh	2000	-0.12	No	Yes	Possible	-0.05	No	Moderate
Bangladesh	2004	-0.11	No	Yes	Possible	-0.06	No	Moderate
Benin	2001	-0.10	No	Yes	Possible	-0.05	No	Moderate
Bolivia	1998	-0.12	No	Maybe	Possible	-0.07	Yes	Low
Burkina Faso	1993	-0.13	No	Yes	Possible	-0.08	Slight	Moderate
Burkina Faso	2003	-0.14	No	Yes	Possible	-0.09	No	Moderate
Cameroon	1998	-0.14	Slight	Yes	Possible	-0.06	No	Moderate
Cameroon	2004	-0.12	No	Yes	Possible	-0.07	No	Moderate
Chad	1997	-0.14	No	Yes	Possible	-0.10	No	Moderate
Dom. Republic	1999	-0.17	No	Yes	No	-0.15	No	Strong
Ethiopia	2000	-0.18	No	Yes	No	-0.14	No	Strong
Ethiopia	2005	-0.11	No	Yes	No	-0.07	No	Moderate
Guinea	1999	-0.16	No	Yes	Possible	-0.11	Slight	Strong
Haiti	1994	-0.14	No	Maybe	Possible	-0.08	Yes	Low
India	1999	-0.17	No	Maybe	Possible	-0.11	Slight	Moderate
Mali	1996	-0.13	No	Yes	Possible	-0.07	No	Moderate
Mozambique	1997	-0.15	Slight	Yes	Possible	-0.06	No	Moderate
Niger	1992	-0.10	No	Yes	Possible	-0.06	No	Moderate
Niger	1998	-0.14	Slight	Yes	Possible	-0.05	Slight	Moderate
Nigeria	1999	-0.23	Slight	Yes	Possible	-0.16	Yes	Strong
Nigeria	2003	-0.11	No	Yes	Possible	-0.05	No	Moderate
Pakistan	1991	-0.23	No	Yes	Possible	-0.18	No	Strong
Peru	1992	-0.13	No	Maybe	Possible	-0.08	Yes	Low
Turkey	1993	-0.11	No	Yes	Possible	-0.06	Slight	Moderate

(Continued...)

Table 9. – *Continued*

Note: Shaded lines indicate surveys in which the residual relative difference is below -0.10.

(1) Difference between published fertility (last three years) and reconstructed fertility at the same date.
(2) Extent to which displacement of recent births accounts for discrepancies between published fertility and reconstructed fertility.
(3) Whether, based on visual inspection of fertility trends after correcting for displacement, omission of recent births is possible.
(4) Whether, based on visual inspection of fertility trends (15-24), Potter effects are possible.
(5) The *residual relative difference* measures the difference between fertility in the last three years and the reconstructed fertility trends, after correcting for displacement and Potter effect (Potter effect set at 10 percent), as shown in Appendix Figure A4.
(6) Whether, based on visual inspection of fertility trends in Appendix Figure A4 and trends in education in Appendix Figure A5, differences in sample implementation may explain the discrepancies.
(7) This is a subjective evaluation of the degree of omission after taking into account other possible sources of discrepancies. Surveys with a residual relative difference under -0.10 are classified in the “strong” category. Surveys with residual relative differences between 0 and -0.05 are classified in the “low” category.

3.3.4. Do variations in sampling implementation account for discrepancies?

Some of the discrepancies in fertility estimates may be due to differences in sample implementation. If high fertility women are underrepresented or overrepresented in a survey by accident, we expect fertility in that survey to be below or above fertility in another survey for all time periods. The estimate of recent fertility will thus be underestimated or overestimated. This sampling problem will influence the reconstructed trend in the same direction, pulling the average trend downward or upward; however, because the reconstructed trend is based on pooled surveys, the impact will be less pronounced. This issue of sample composition is illustrated with the case of Haiti (Figure 13 and Figure 15). While fertility decreases in the few years preceding the first survey (sharply in Figure 13, less sharply in Figure 15), reflecting possible omission of births, Figure 15 also suggests that low fertility women were oversampled in the first survey, because the reconstructed trend appears below the trends of subsequent surveys. In this case, part of the difference between recent fertility in the first survey and reconstructed fertility may be due to differences in sample composition. Ethiopia is another example of possible differences in sample composition, with high fertility women possibly underrepresented in the first survey (lower fertility). Appendix Figure A4 shows that among the 26 surveys, differences in sample composition may have an impact in 6 to 8 surveys (in Bolivia, Ethiopia, Haiti, India, Niger, Nigeria, Pakistan, and Peru). In contrast, differences in sample composition appear less likely in the other countries.

This issue can be further checked by estimating retrospectively the composition of the sample for some socio-demographic characteristics in a specific age group (characteristics that are time invariant, or for which time-varying characteristics are available). Here, the proportion of women age 15-34 with at least six years of education for the 15 years preceding the survey is computed.[26] As for total fertility rates, the retrospective estimates of educational levels should match across surveys for the same periods. Results are presented in Appendix Figure A5 for the 18 countries with 26 surveys in Table 9. In half of the countries, education levels match very well across surveys, suggesting that differences in sample composition are not a significant issue. In six countries, differences are visible, but relatively small. In contrast, in four countries (Bolivia, Haiti, Nigeria, and Peru), differences in sample composition are large. The Nigerian case is particularly compelling. In the second survey (1999), the percentage of women with six years of education is much larger than in the first and third surveys; this difference helps to explain the much lower fertility in the 1999 survey. In Haiti, the first survey also included a larger proportion of educated women than the following surveys; this confirms the role of differences in sample composition in the lower fertility reported in the first survey in Haiti. In the 1991-92 survey in Peru, some rural areas could not be visited because of security reasons, and this sampling issue was acknowledged in the 1991-92 DHS survey report.[27] In Bolivia, the two most recent surveys show lower fertility levels, and also include higher proportions of educated women compared to the first two surveys, reflecting differences in sample implementation. Overall, these results indicate that sample composition is a potentially serious issue in four of the 26 surveys. Omission of recent births appears to be a plausible explanation in surveys where residual differences cannot be explained by sample composition, which is the case in most surveys.

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[26] The method is simple: at the time of the survey, the percentage of women age 15-34 with secondary or higher education is computed directly. One year before the survey, the percentage of women age 15-34 with secondary or higher education is equal to the percentage of educated women age 16-35 at the time of the survey, who were age 15-34 one year before the survey. This operation can be repeated for 15 years before the survey. Fifteen years before the survey, the percentage is estimated among women age 30-49 at the time of the survey. The percentages could be estimated over a longer time period if the age range were restricted; alternatively, a shorter time period should be taken if a larger age range was used. We selected the 15-34 age range, as a large part of fertility is achieved by age 35, and this allows reliable comparisons across surveys.

[27] In the report of the 1996 Peru DHS, a new estimate of fertility for the 1991-92 survey (4.0 children, instead of 3.5) was computed using weights to account for areas that were not surveyed in 1991-92.

4. Conclusion

In this report, reconstruction of fertility trends and comparison of trends across successive surveys were used to evaluate the quality of data from birth histories collected in DHS surveys. The overall picture emerging from these analyses is that DHS fertility estimates are very good in some countries (e.g., Armenia, Colombia, Indonesia, and Morocco), are acceptable in many countries (e.g., Jordan, Kenya, and Zimbabwe), and are poor in other countries (e.g., Benin, Ethiopia, Niger, Nigeria, and Pakistan).

The comparison of published fertility and reconstructed fertility was used as a starting point to explore the causes of inconsistencies across surveys. Good quality data should lead to small differences between reconstructed and published estimates. Results indicate that published fertility is lower than reconstructed fertility in most surveys. Although the differences are small or moderate in most surveys, some surveys are affected by large differences. Several proximate causes of the discrepancies between published fertility and reconstructed fertility were explored. Displacement of recent births in the birth history table of the DHS questionnaire is widespread, but the problem is only marginally related to the discrepancy between published and reconstructed fertility. Three other factors were explored in 26 surveys where discrepancies were large. *Potter effects* appear as a possible explanation for part of the discrepancies. While the approach we used does not allow measuring the Potter effect in a precise way, the patterns of fertility at young ages are compatible with a Potter effect in many of the 26 surveys identified as the most problematic. Correcting for the upper value of the Potter effect leads to smaller discrepancies between published and reconstructed fertility, but in all the surveys discrepancies remain. *Differences in sample implementation* may account for discrepancies in a few surveys, but do not seem to be a significant issue in most surveys. Finally, *omissions of recent births* may contribute to the discrepancies in most countries. While it is difficult to measure omission precisely, ruling out alternative explanations and correcting for other data quality problems still leaves differences between reconstructed fertility and published fertility, indicating omission of births is a possible explanation.

These analyses are to a large extent based on a qualitative assessment of reconstructed fertility, and the results are indicative of broad patterns of data quality. The use of other methods to evaluate birth histories may reinforce or nuance these conclusions. Further in-depth analysis on specific countries would also provide more detailed evaluations and a better understanding of the causes of the data quality issues. What these results indicate is that data quality is an important matter, and that taking published figures of fertility at face value could be risky in some contexts. As shown in this report, not all surveys are equally reliable. Users should be aware that fertility may be underestimated by 5 percent to 10 percent in a number of surveys, and may be more seriously biased downward in a few cases. The use of these figures for evaluating and designing policies, and more generally for describing and projecting fertility changes, should thus be made with this in mind.

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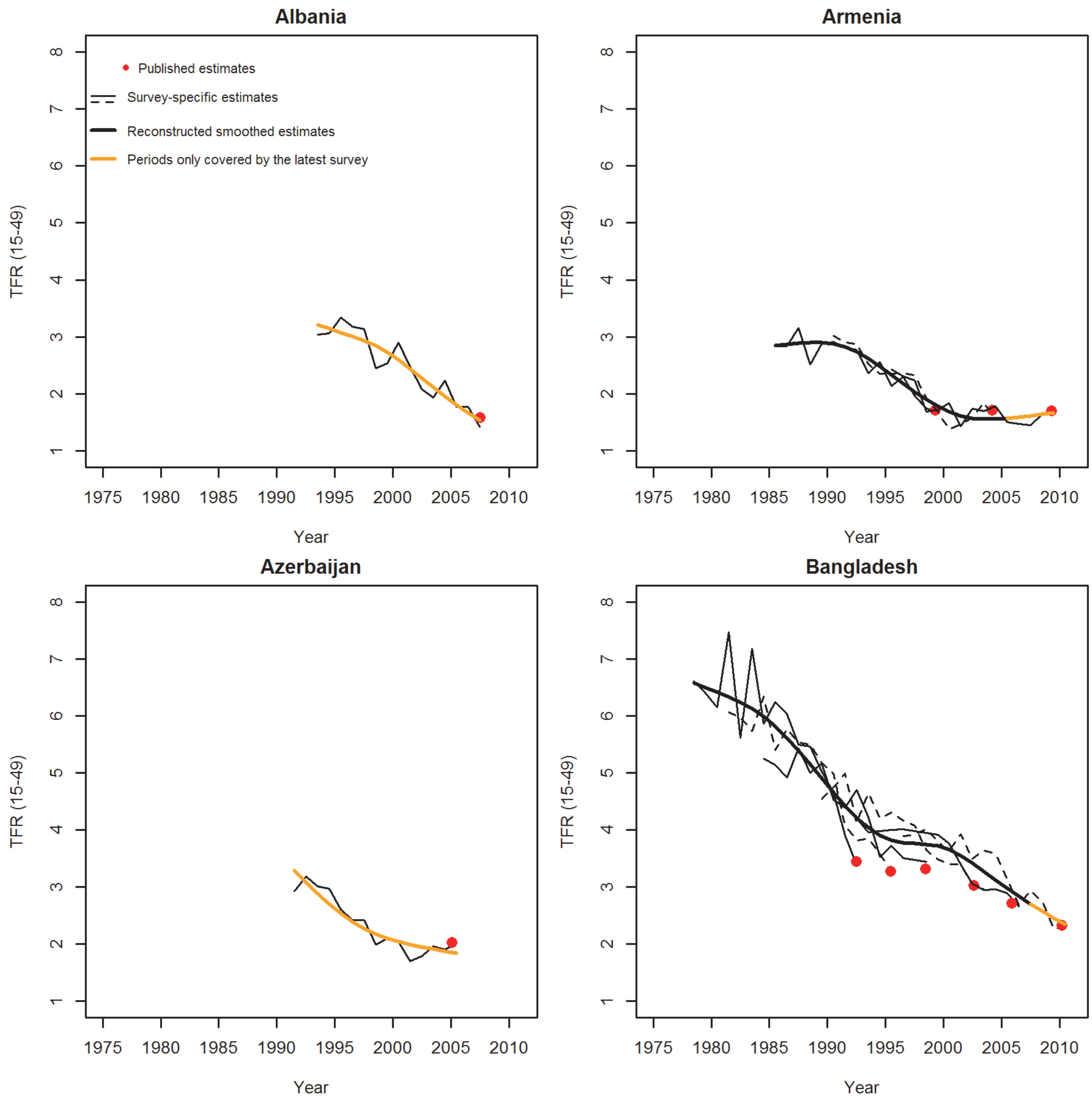
Appendix

Appendix Figure A1. Reconstructed fertility trends by single calendar year, published fertility (last three years), and reconstructed fertility with pooled birth histories in 69 countries (181 surveys)



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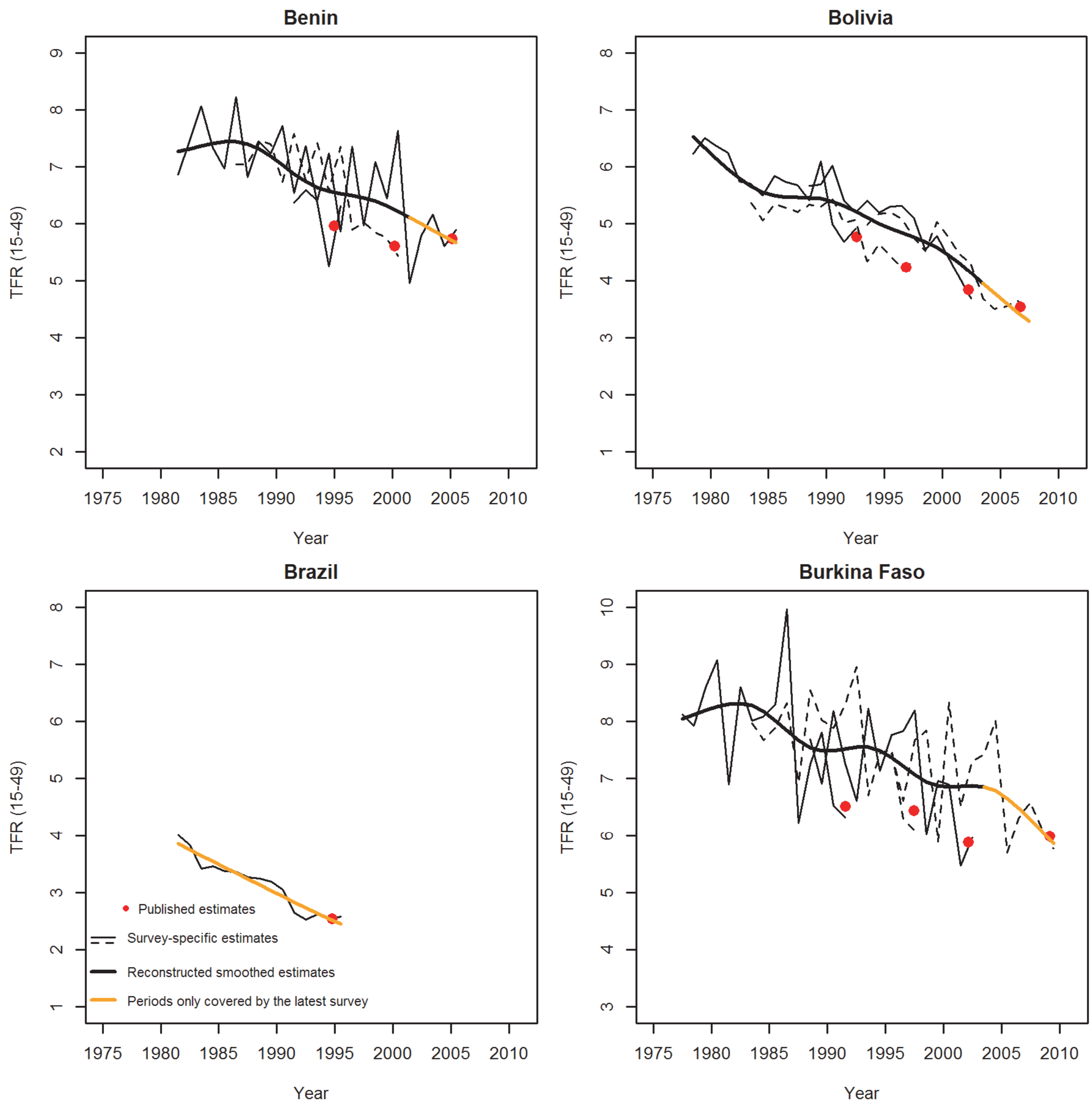

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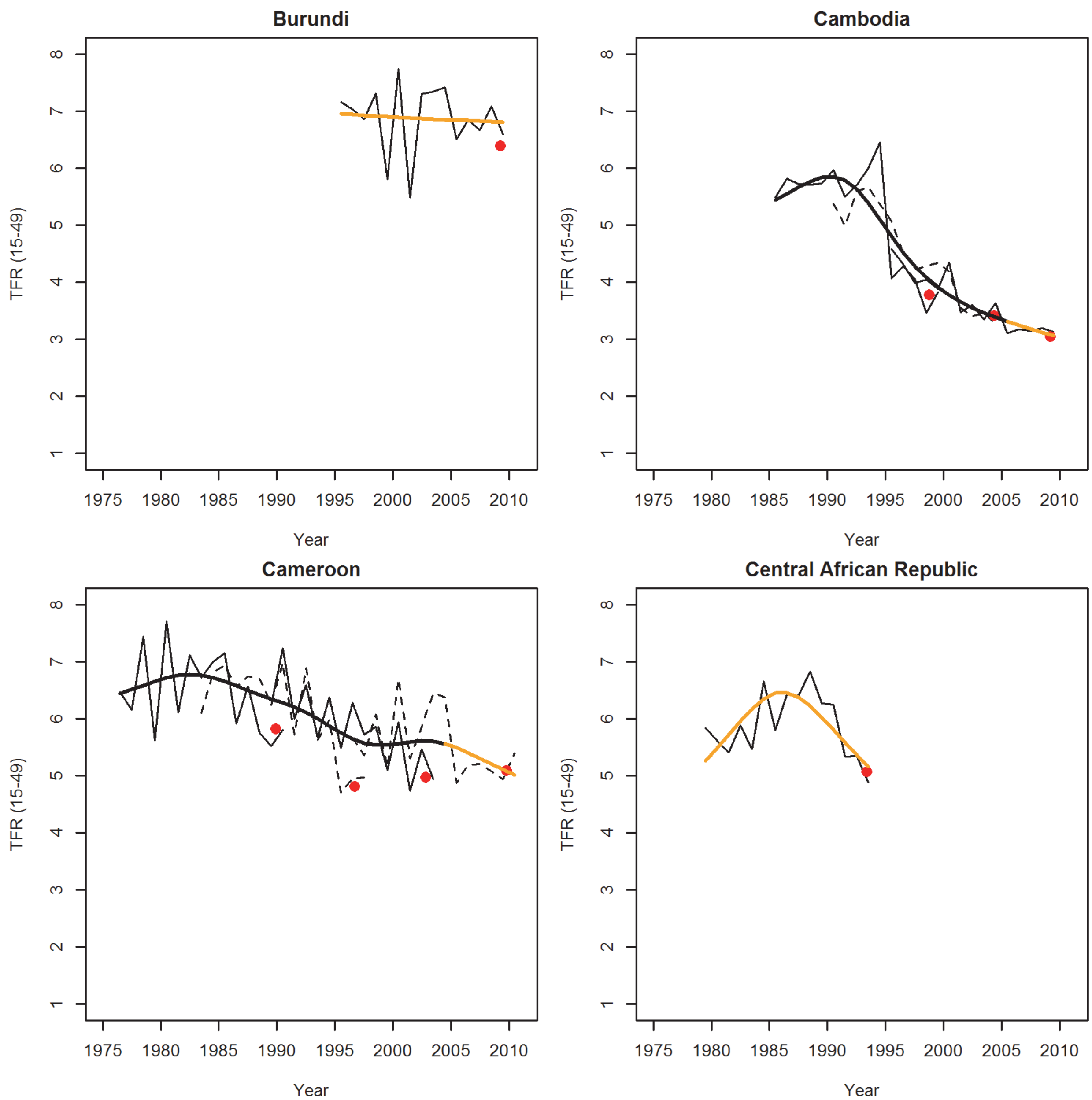

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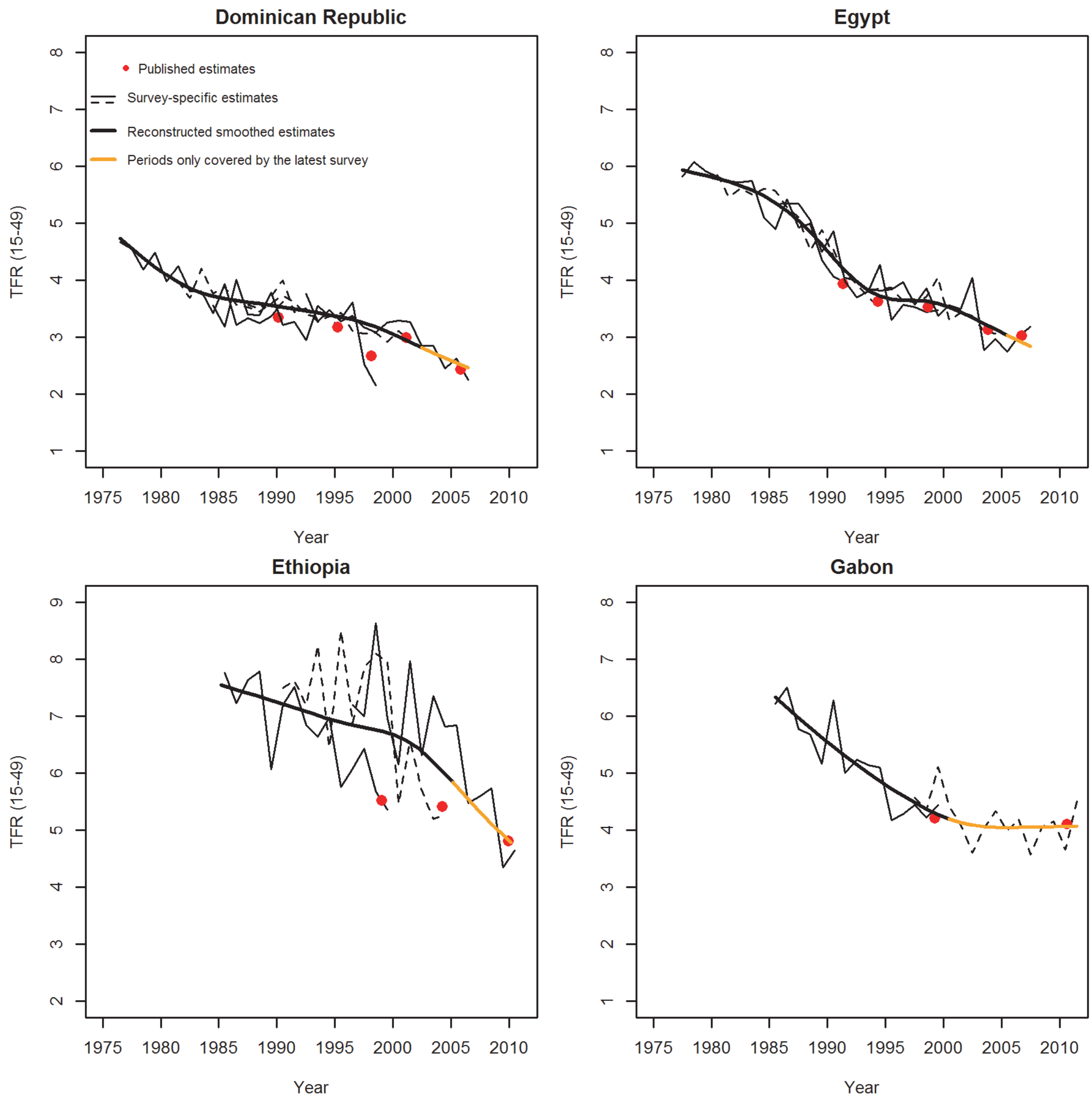

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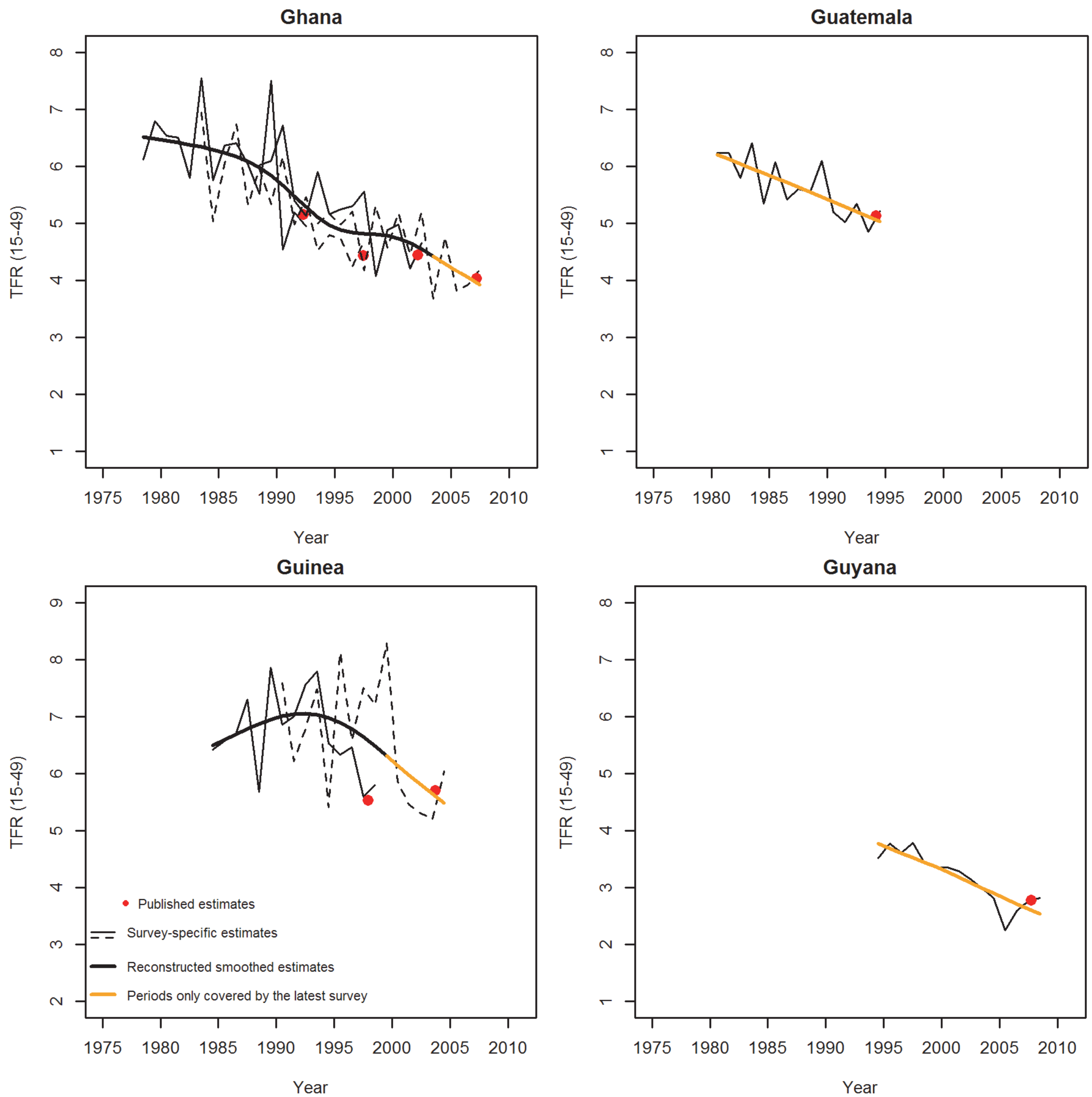

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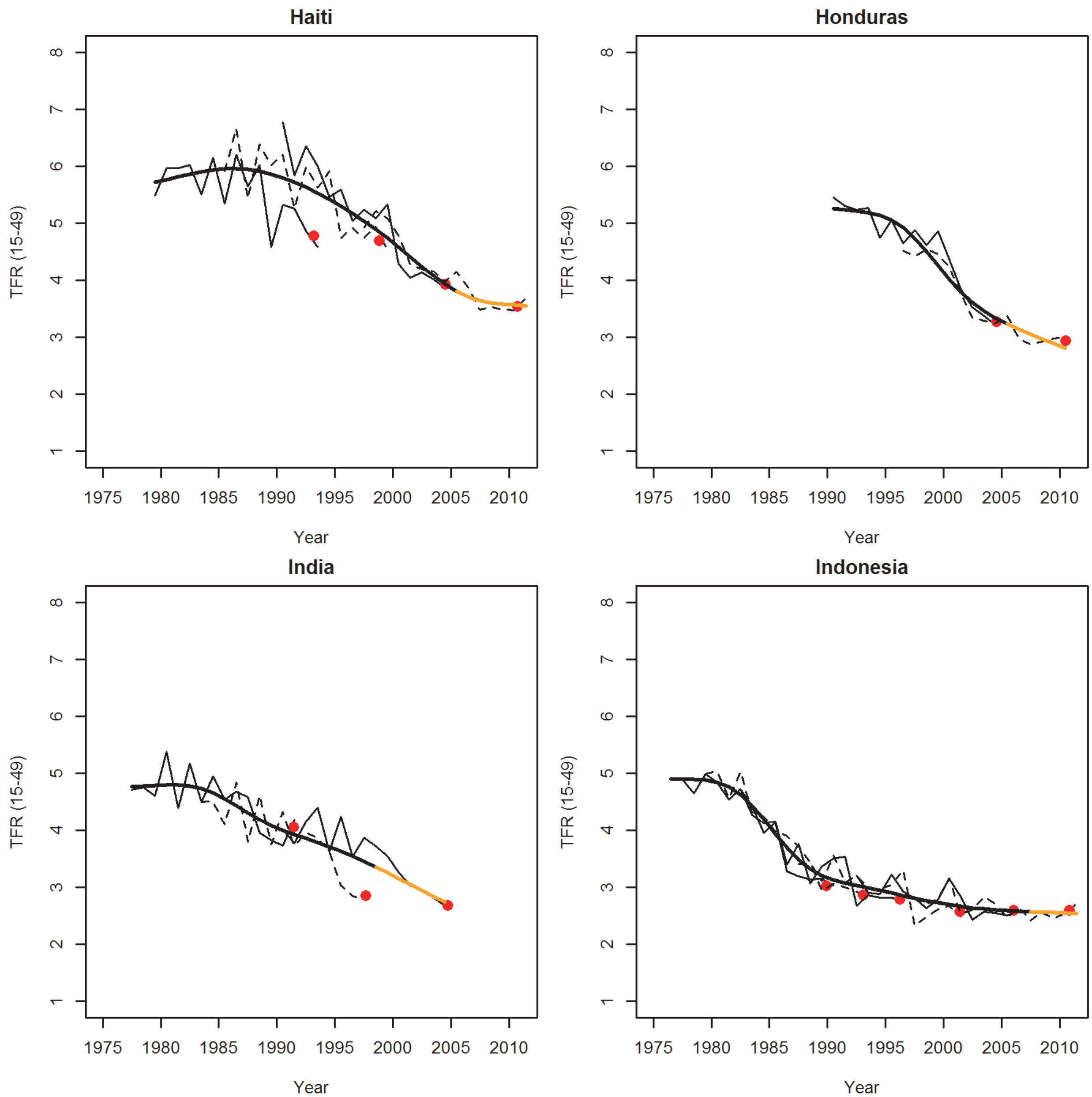

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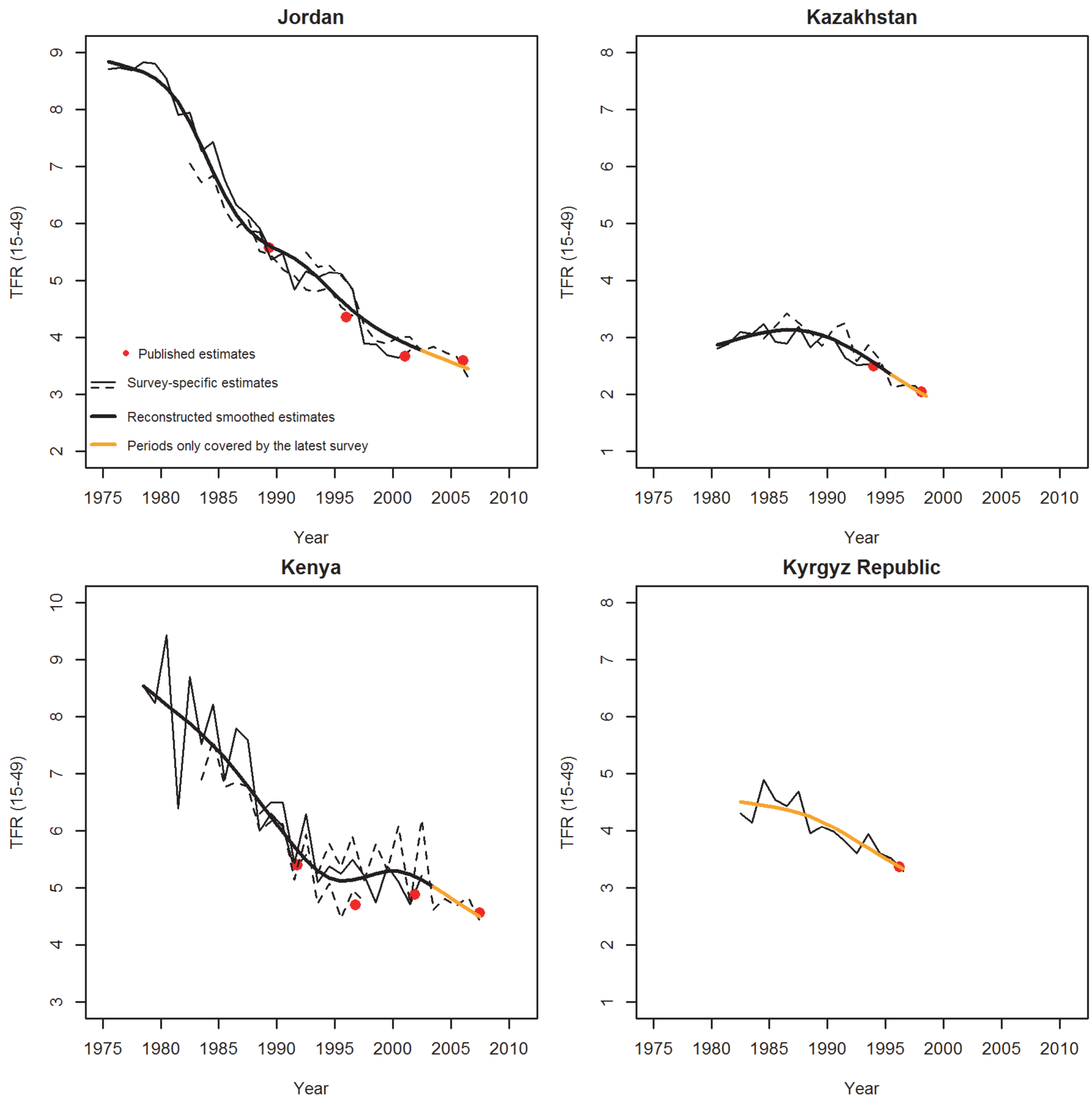

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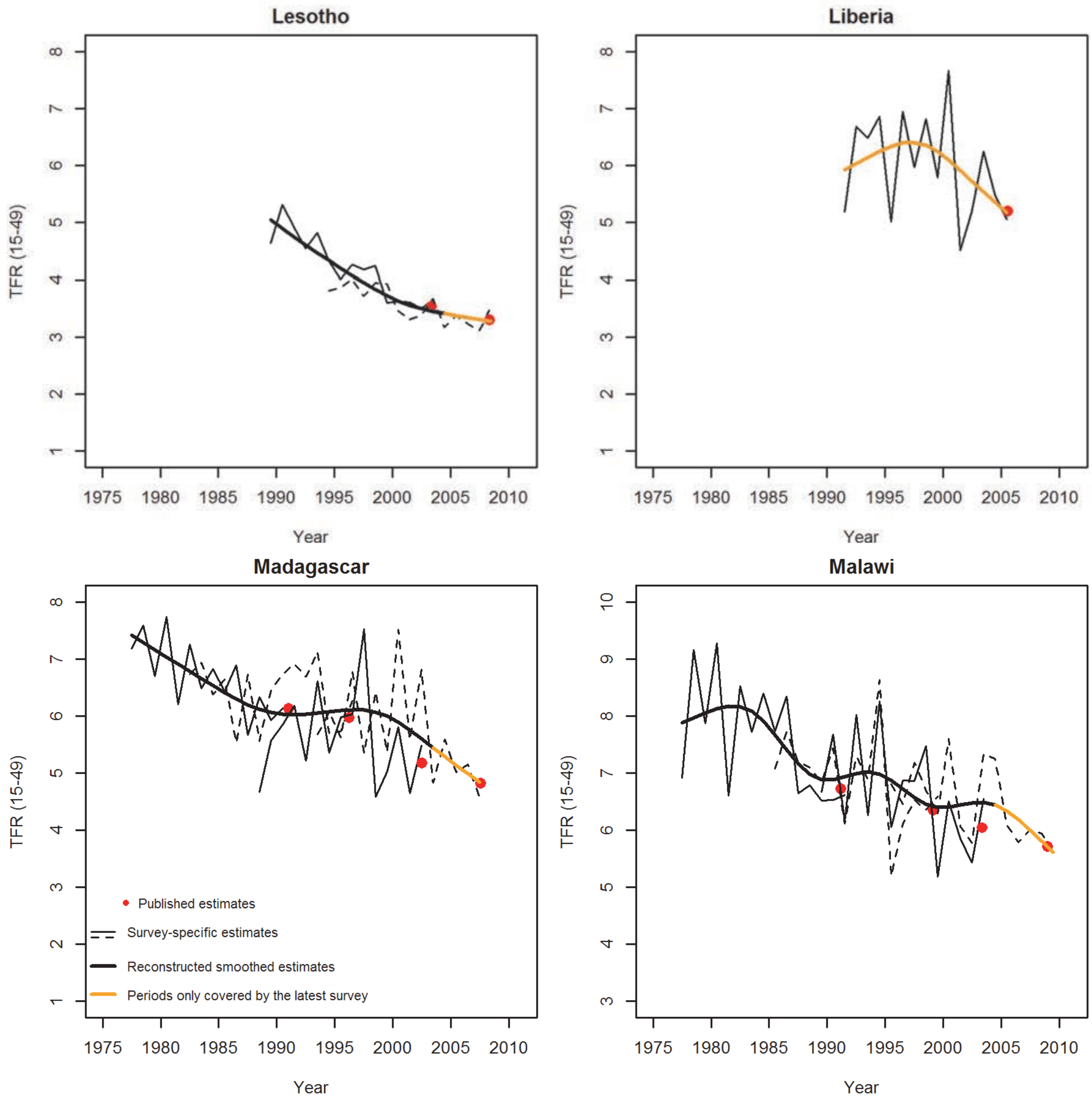

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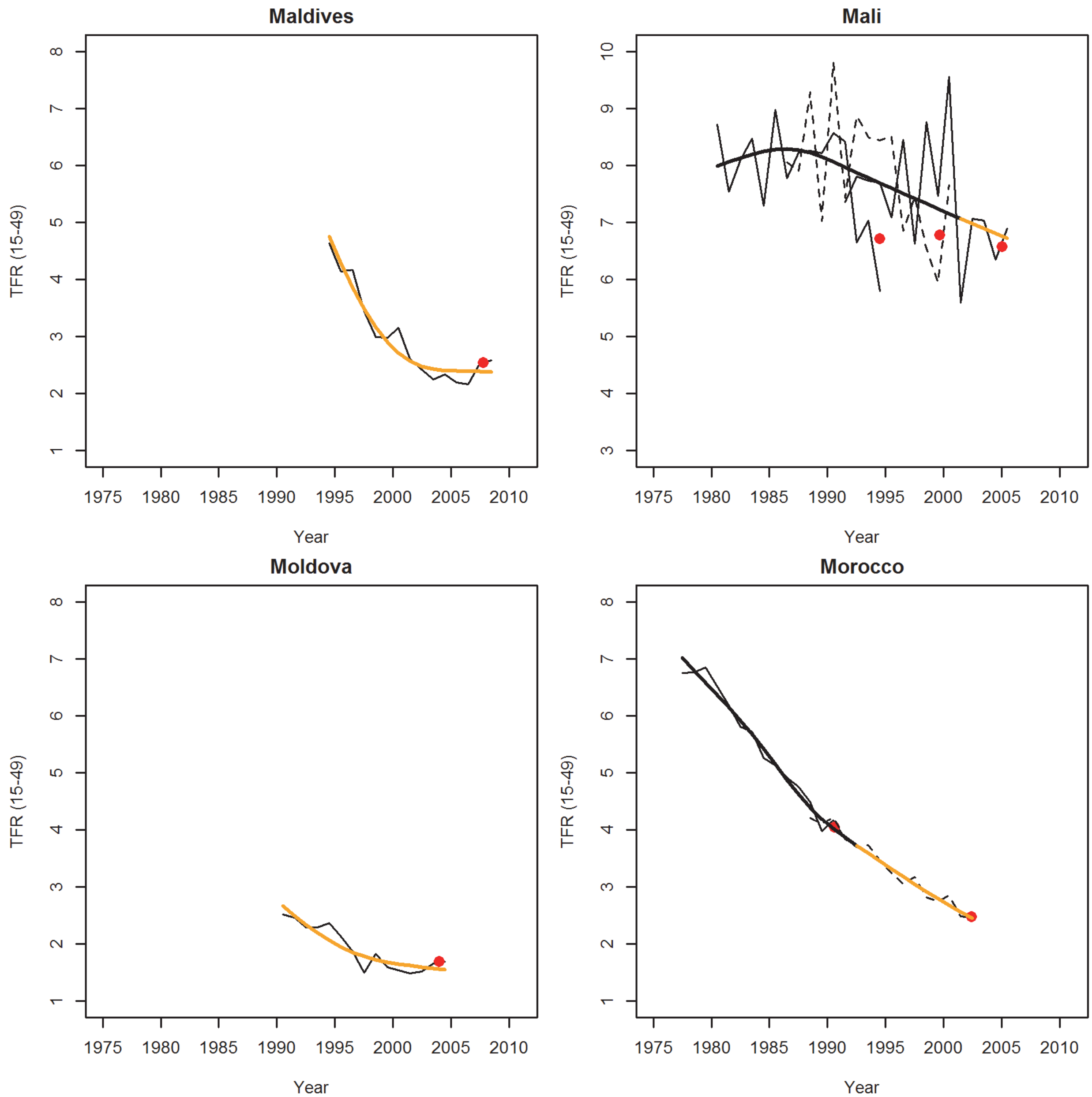

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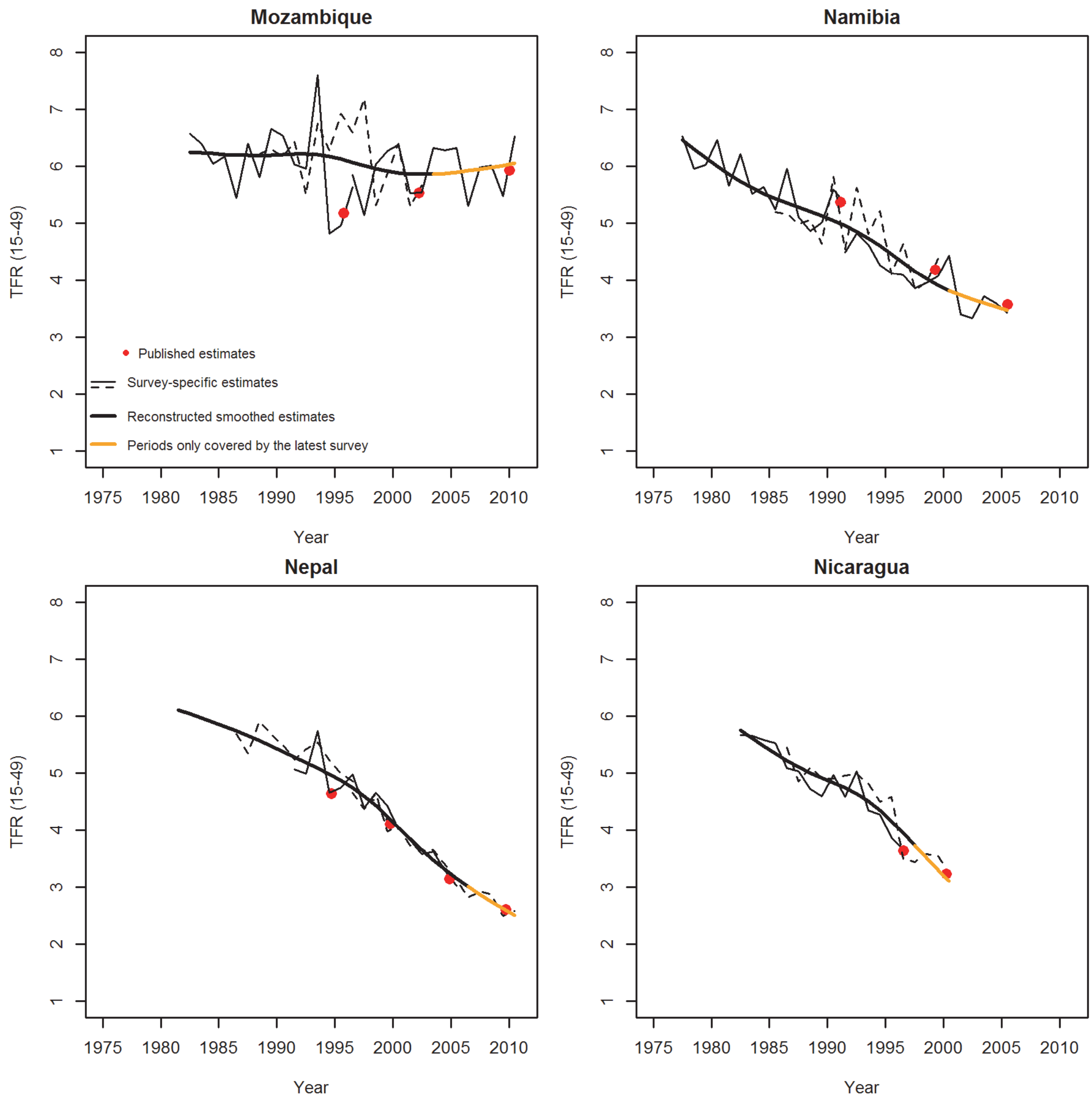

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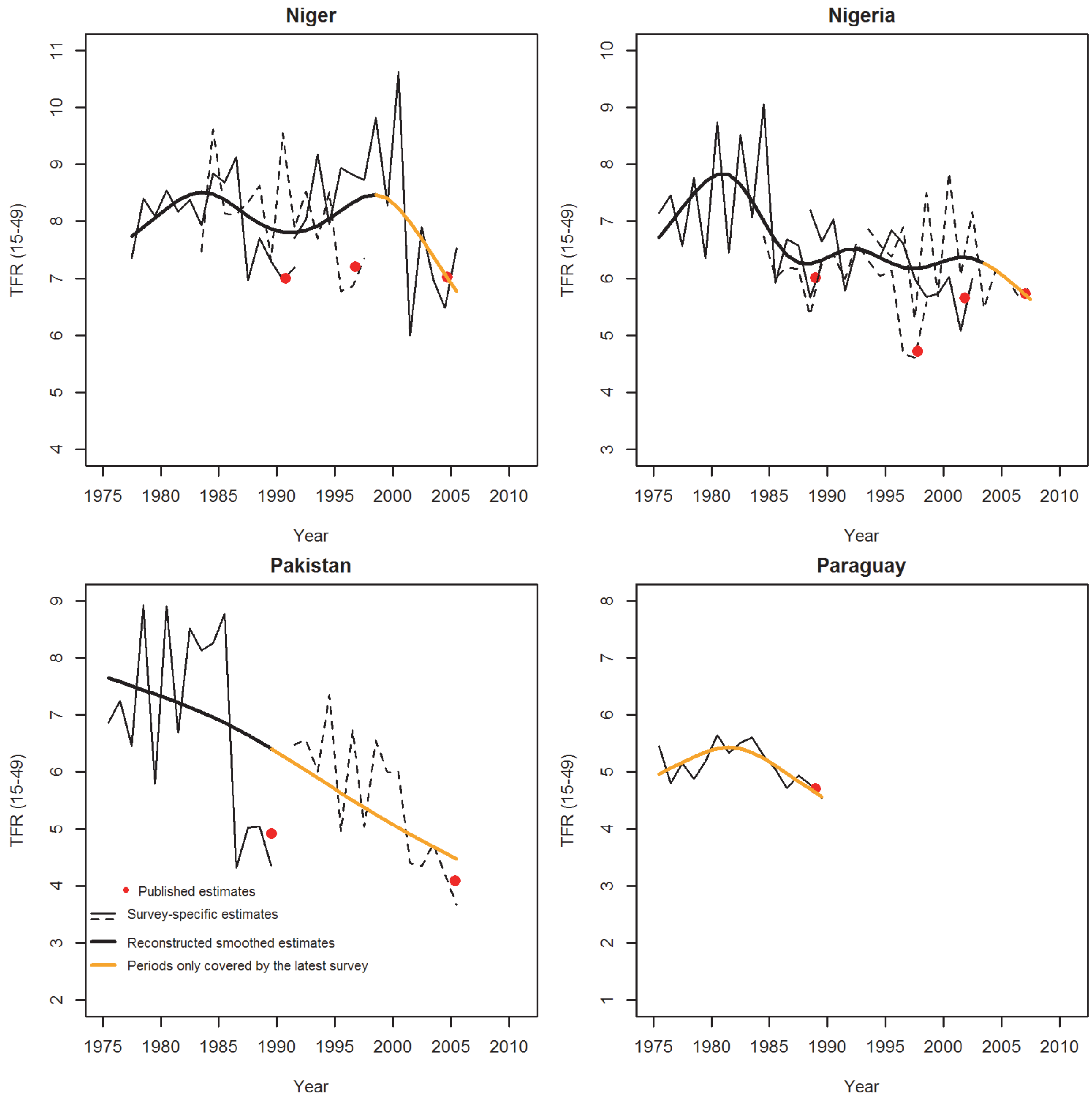

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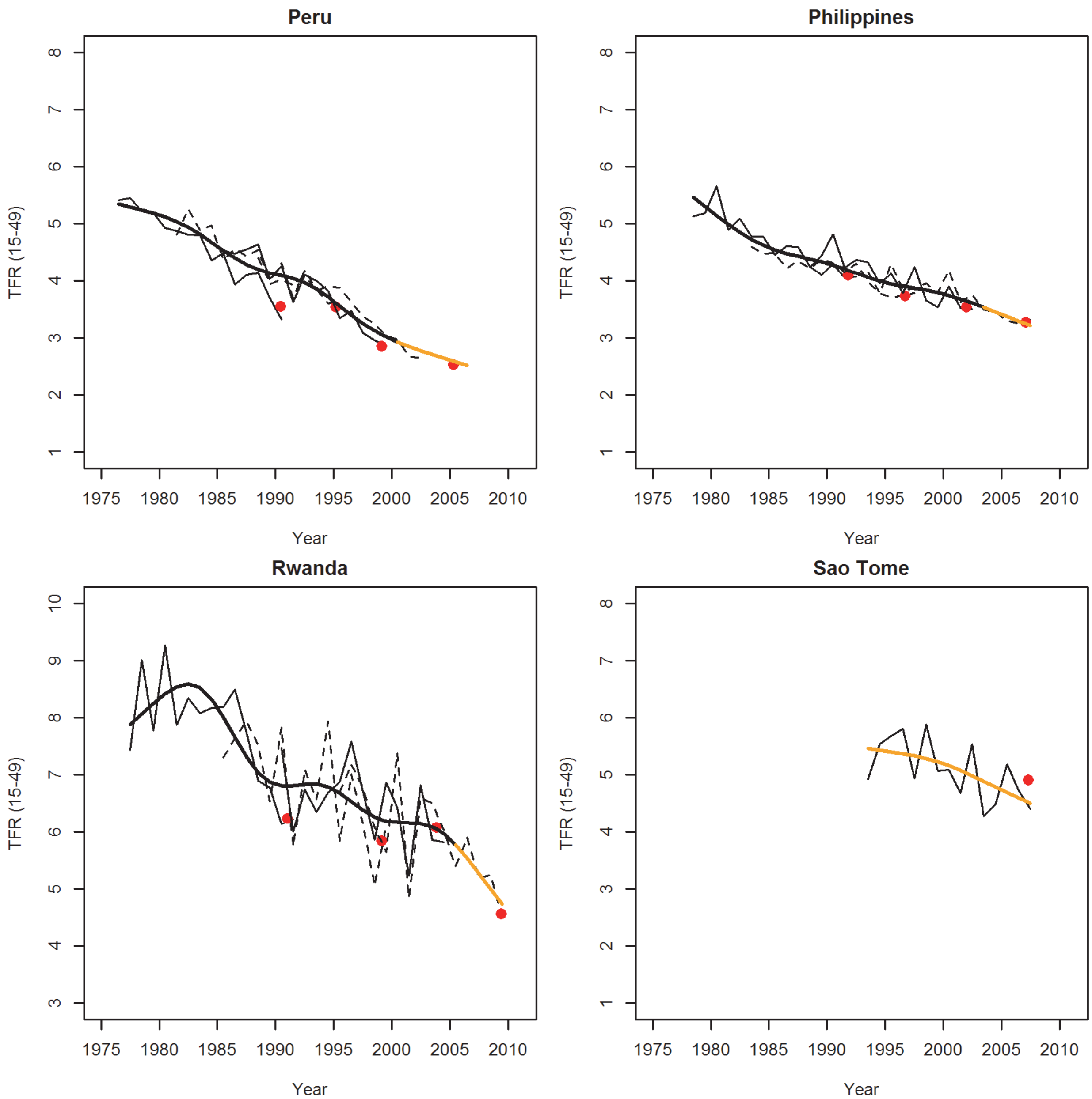

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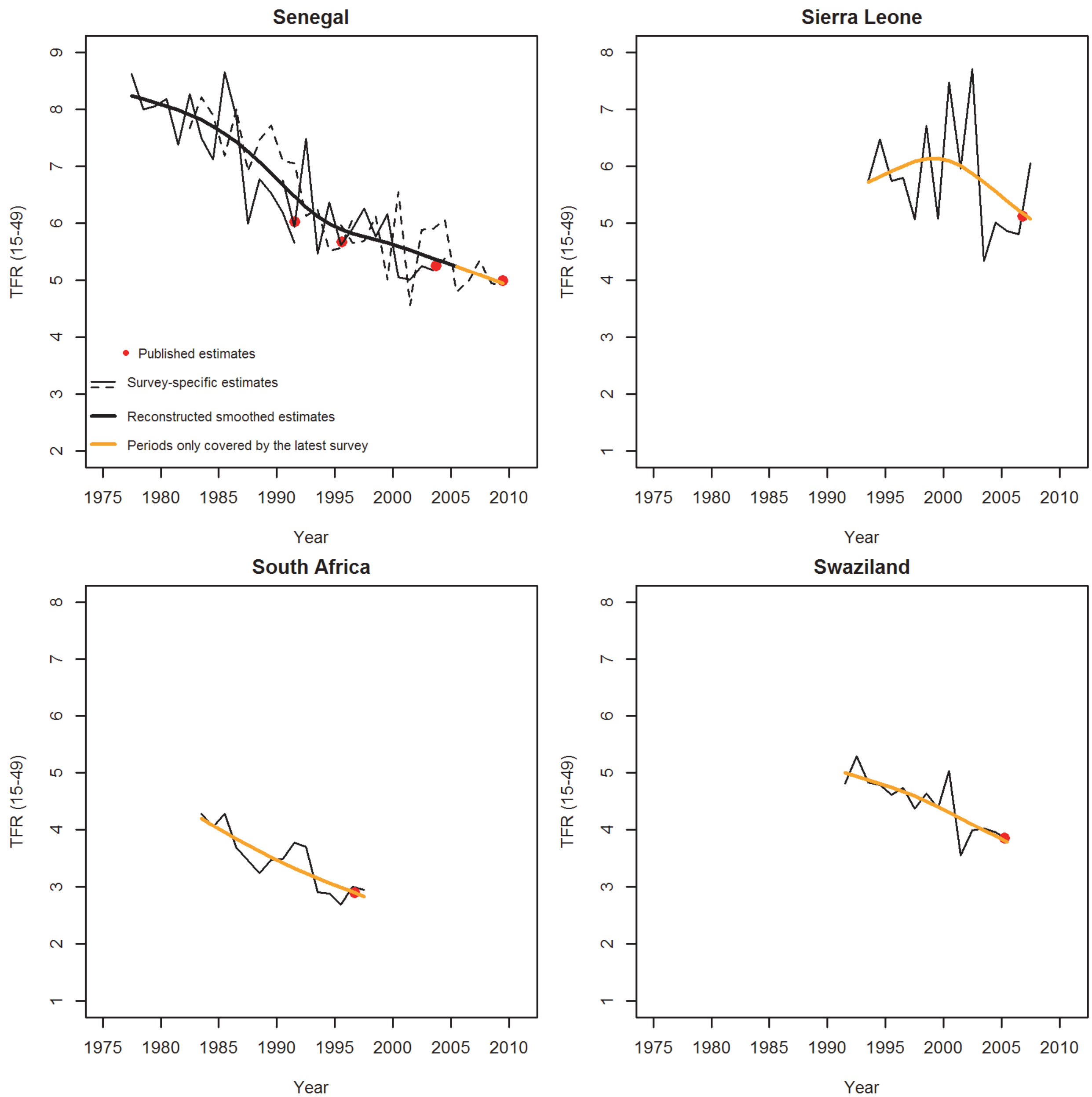

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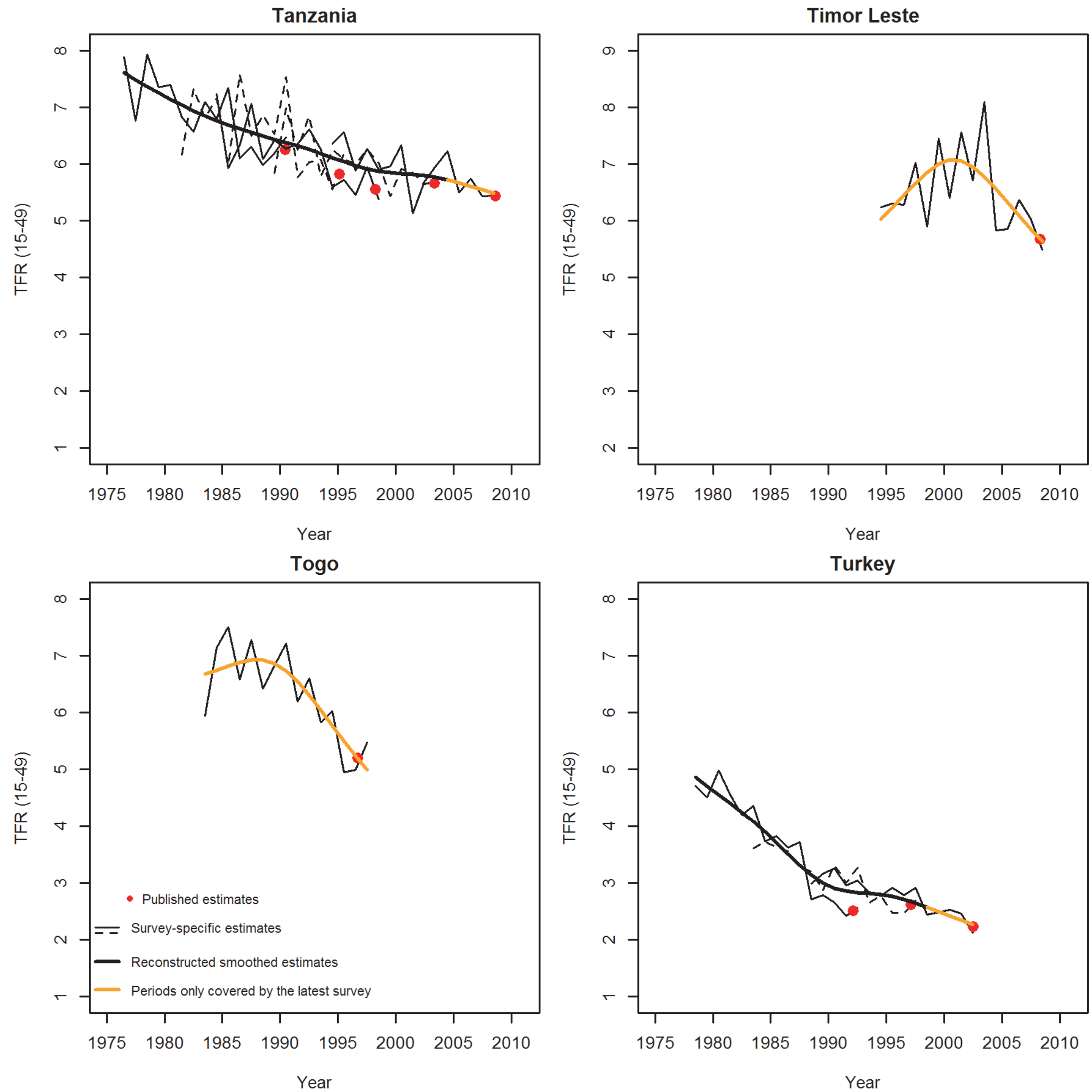

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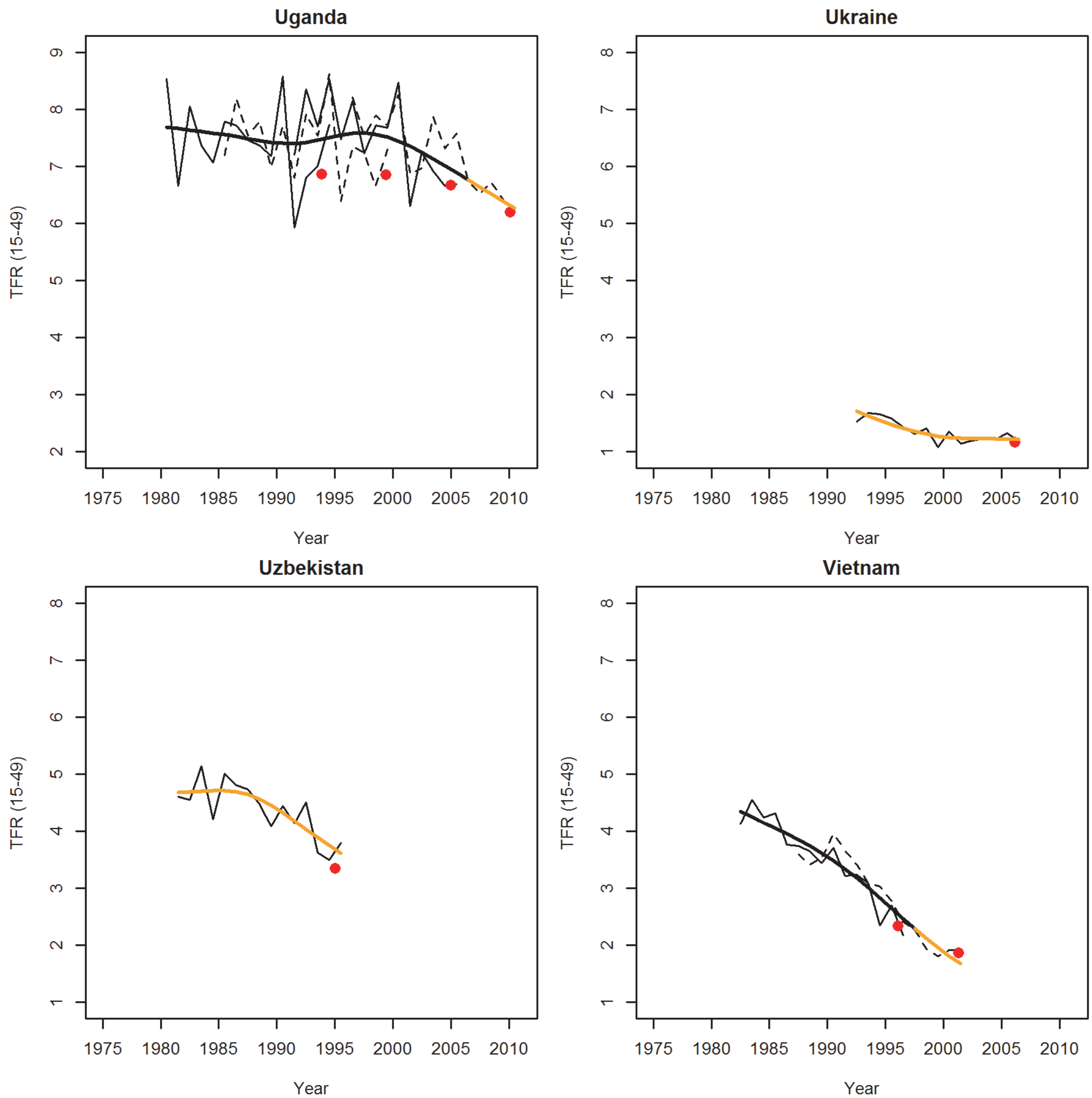

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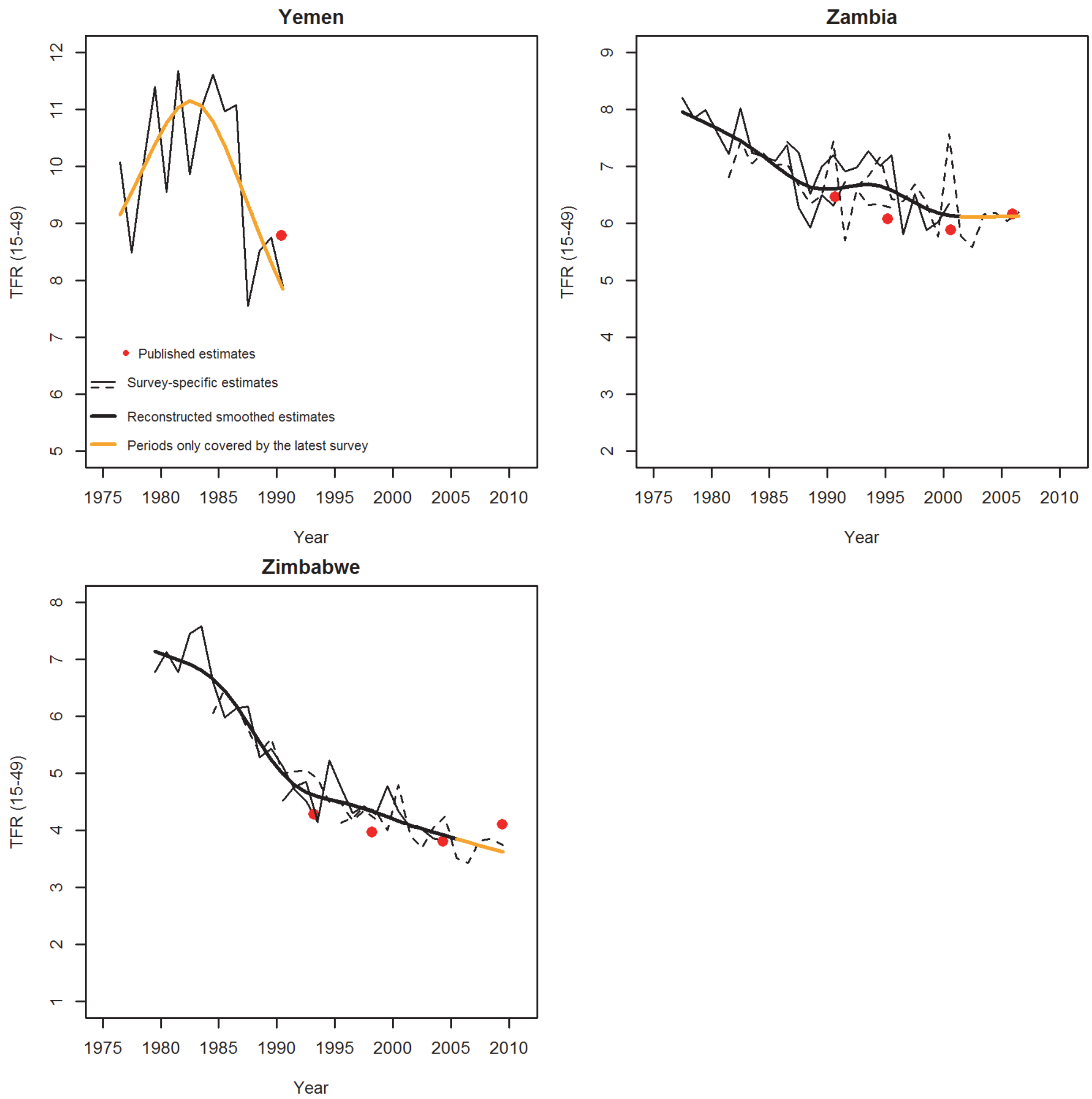
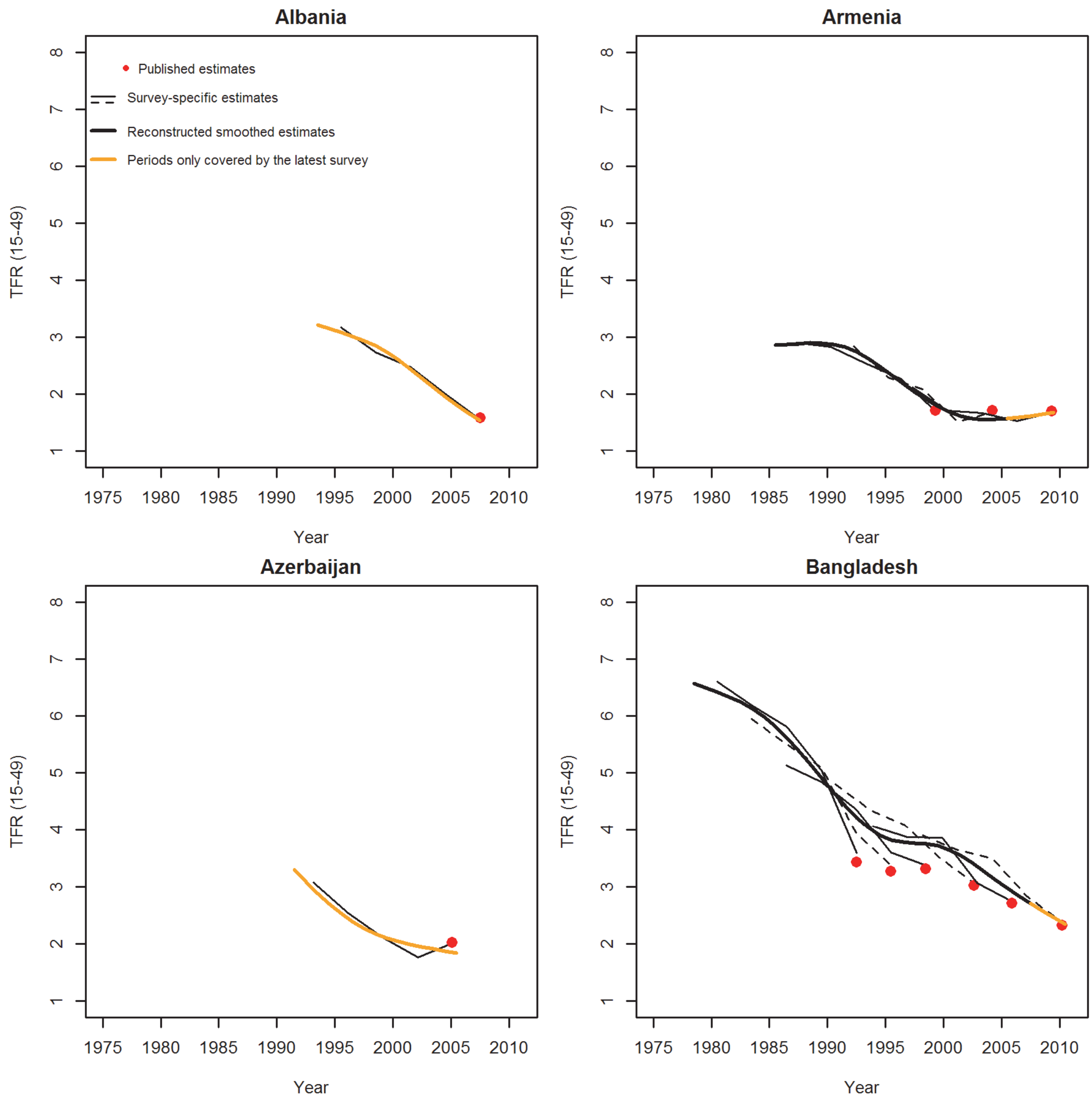


Appendix Figure A2. Reconstructed fertility trends by three-year periods preceding each survey, published fertility (last three years), and reconstructed fertility with pooled birth histories (birth histories corrected for birth displacement), in 69 countries (181 surveys)



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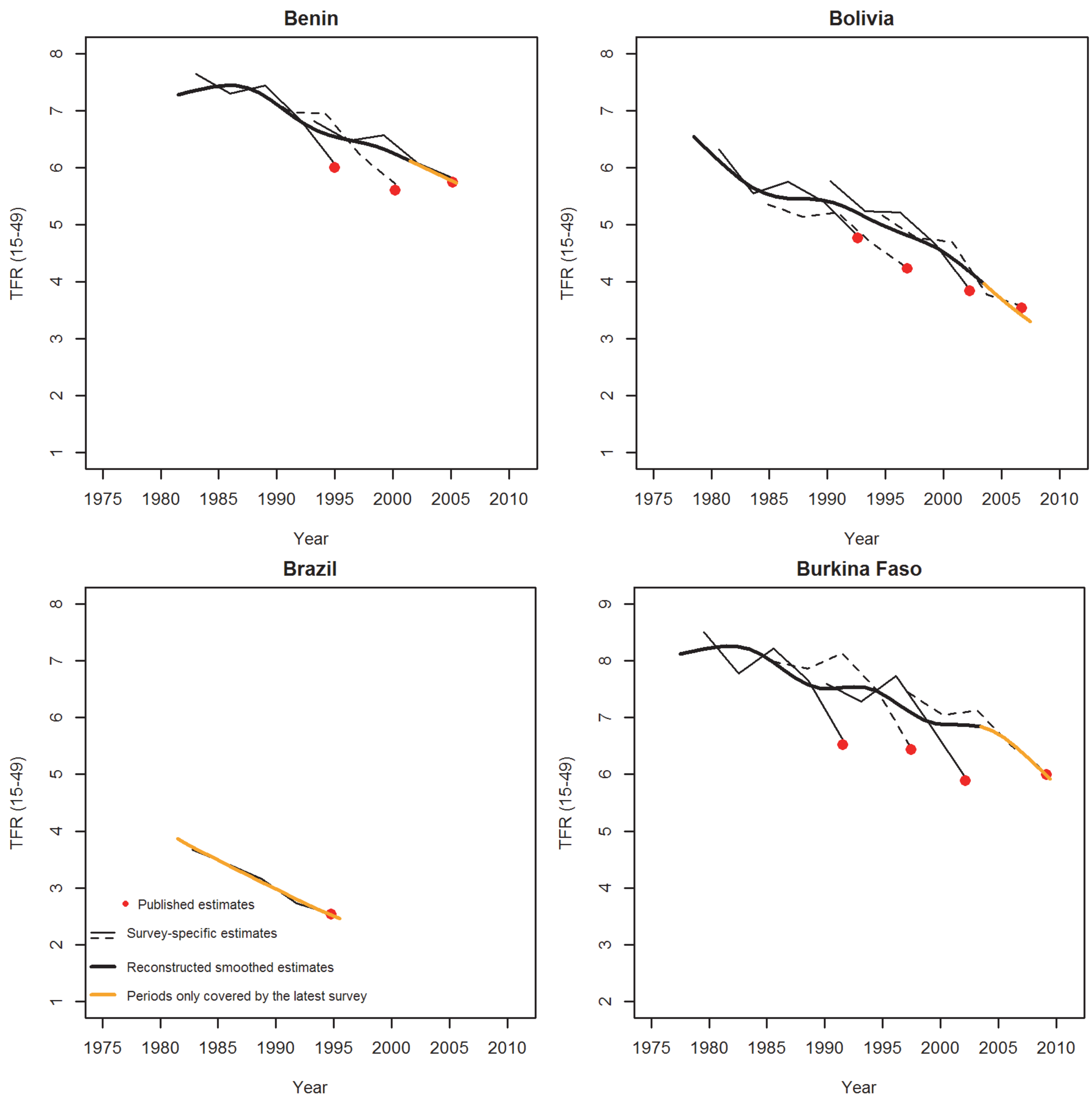

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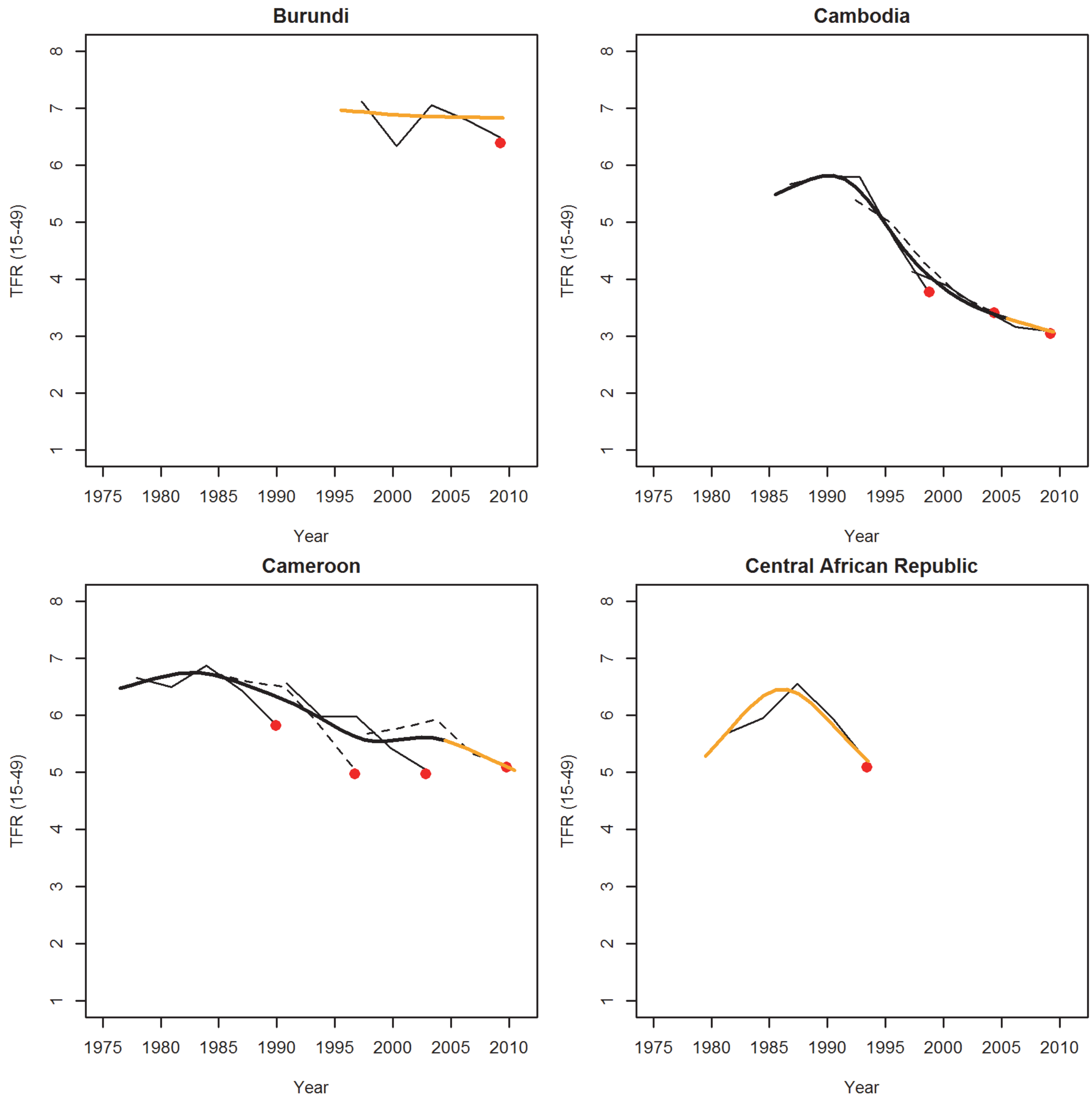

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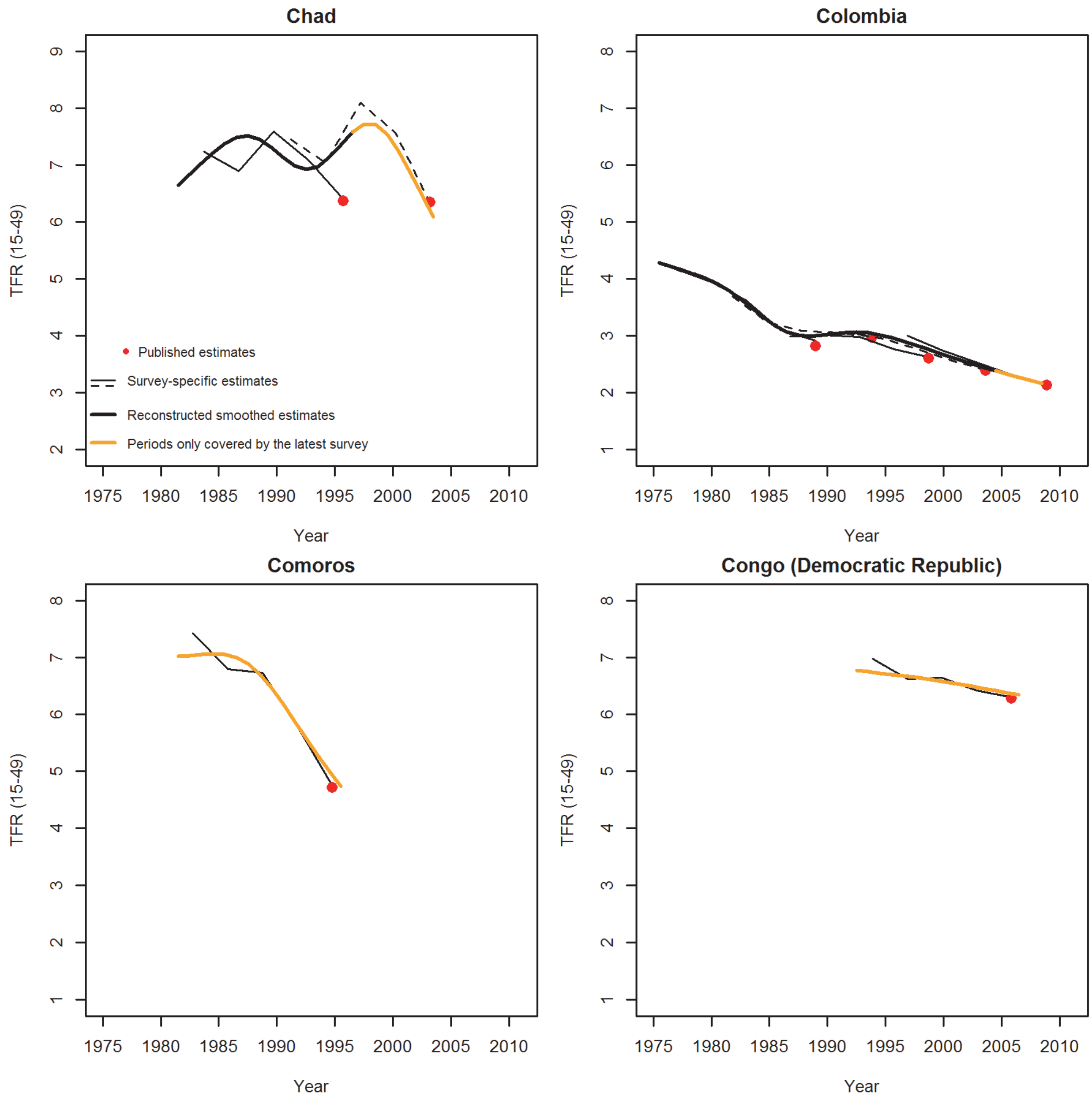

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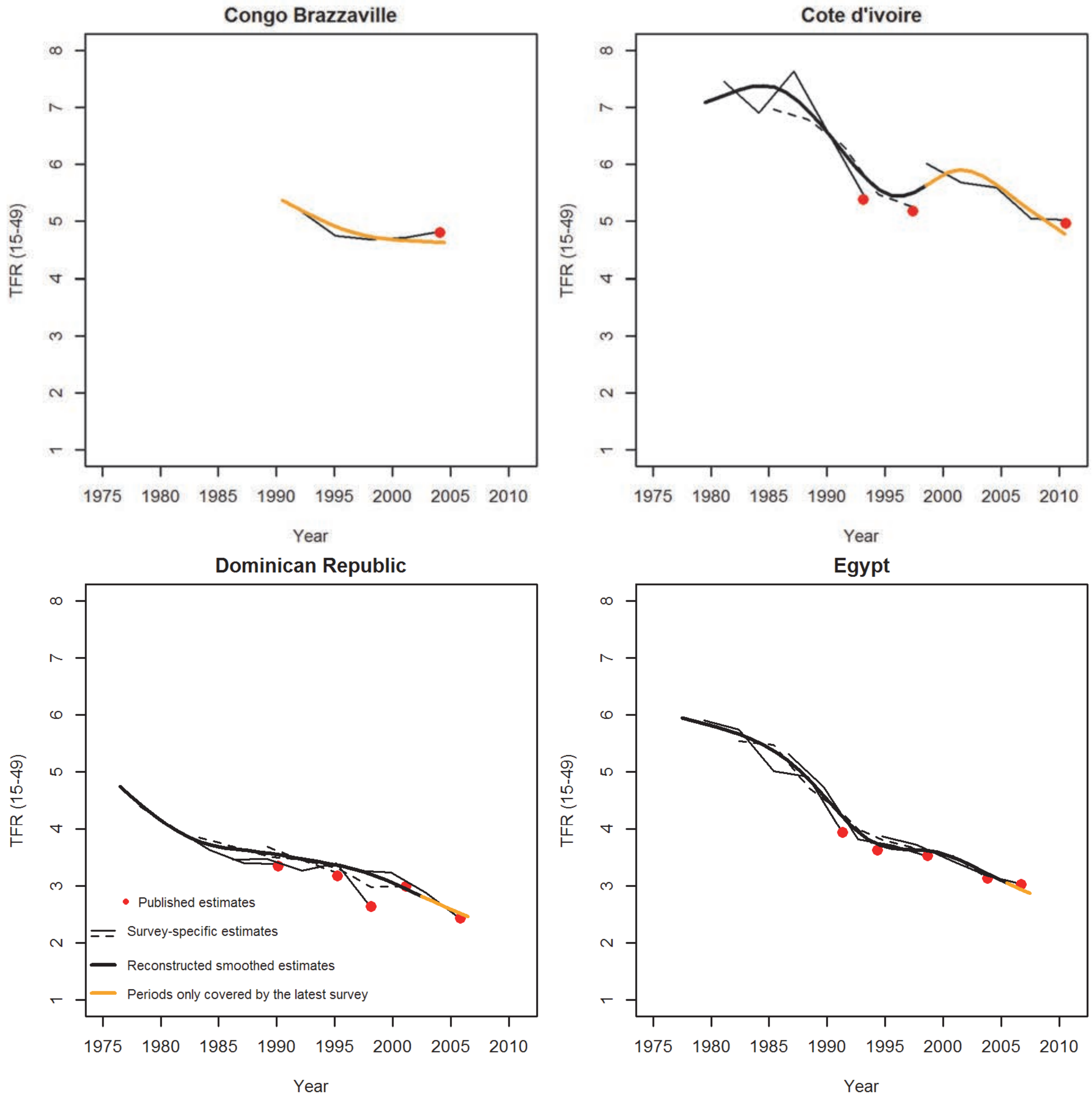

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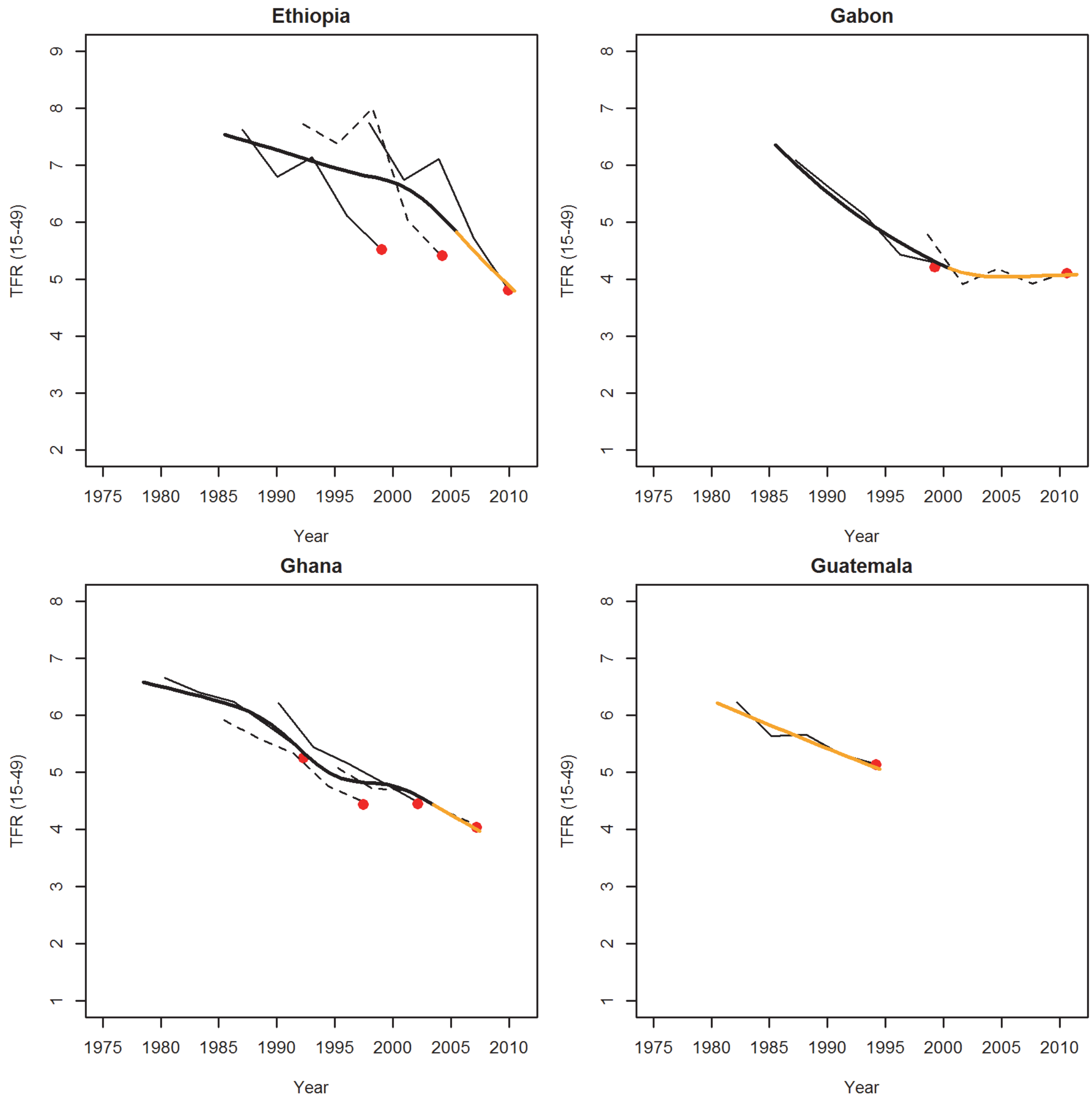

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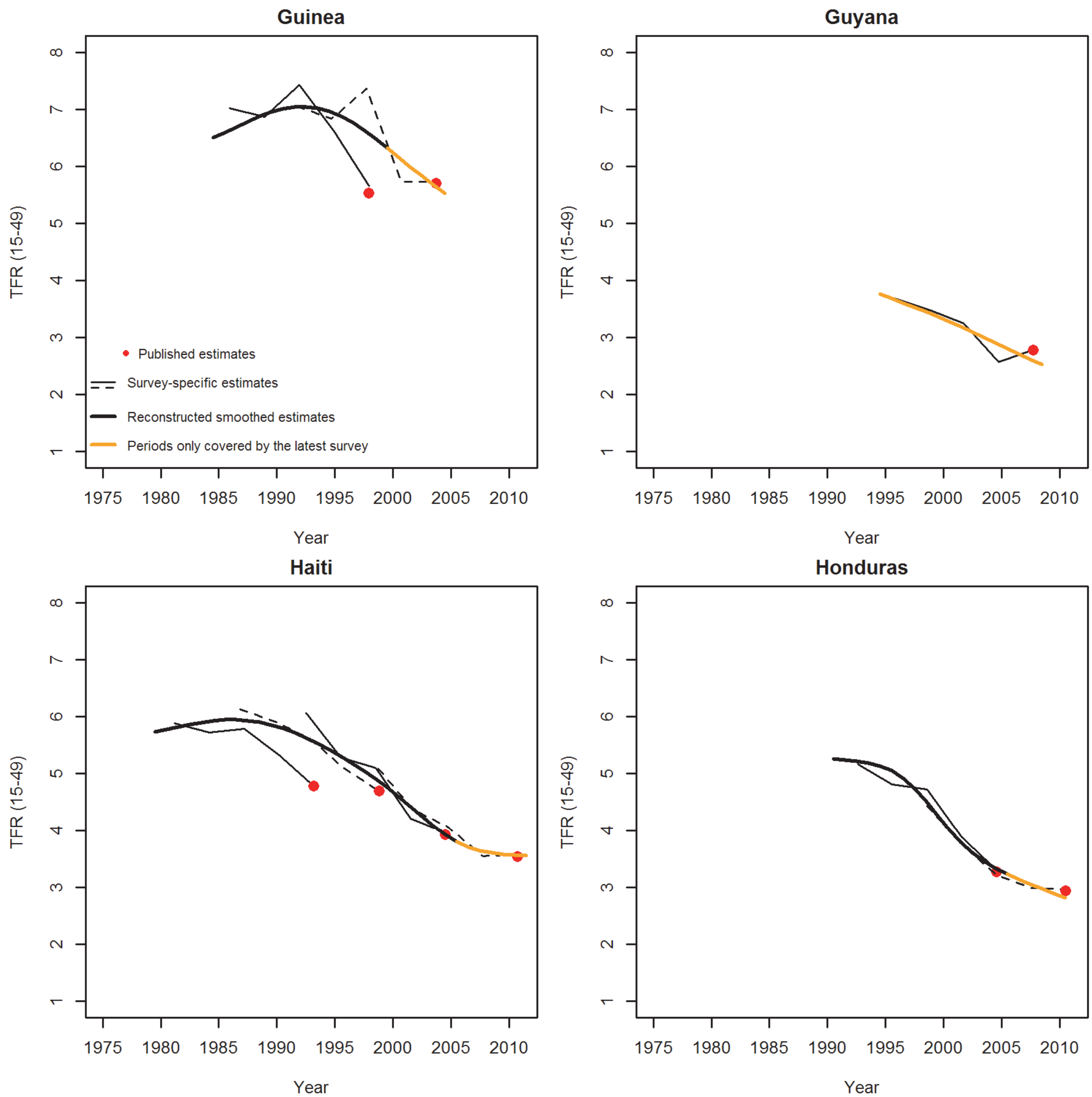

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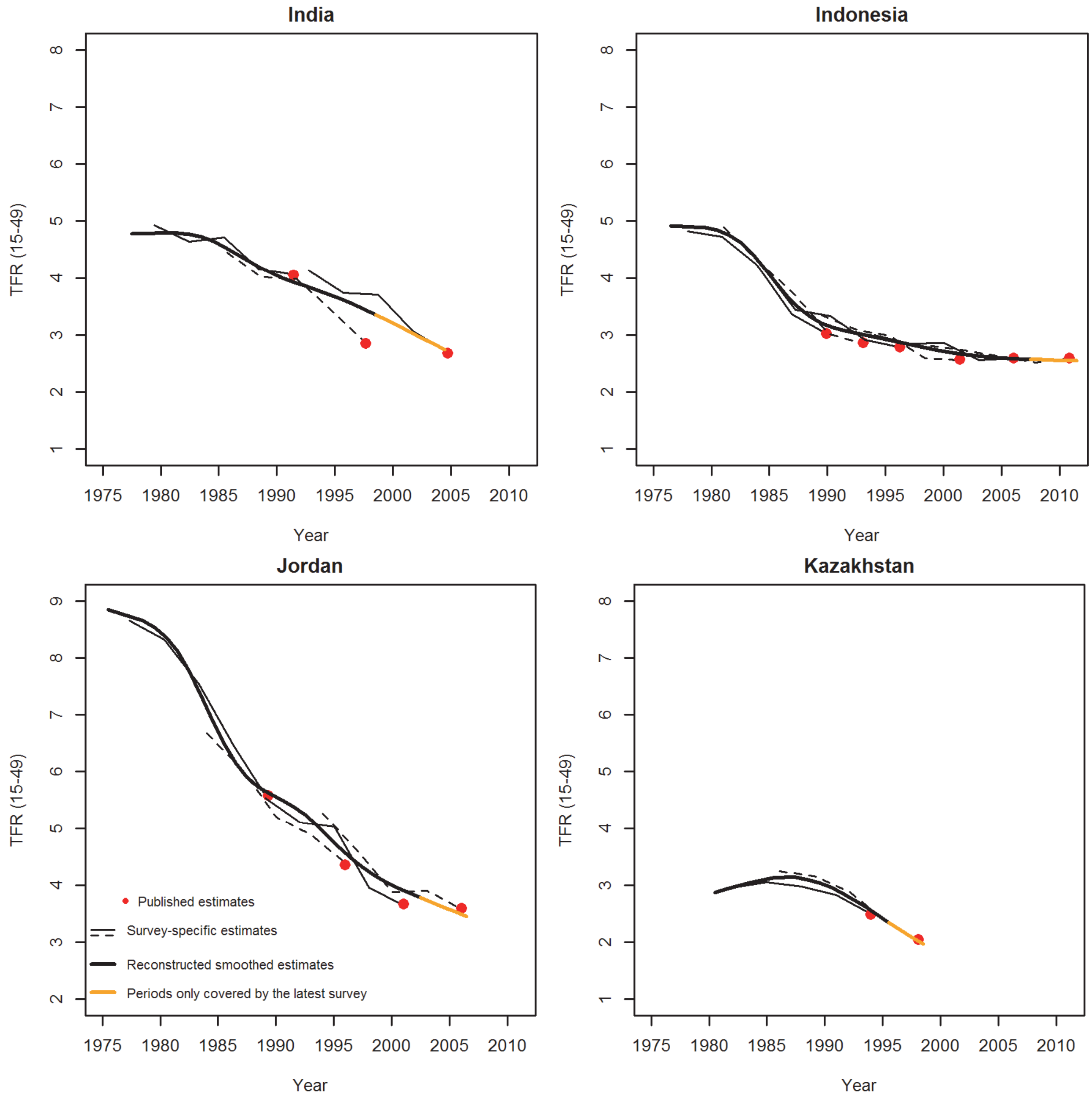

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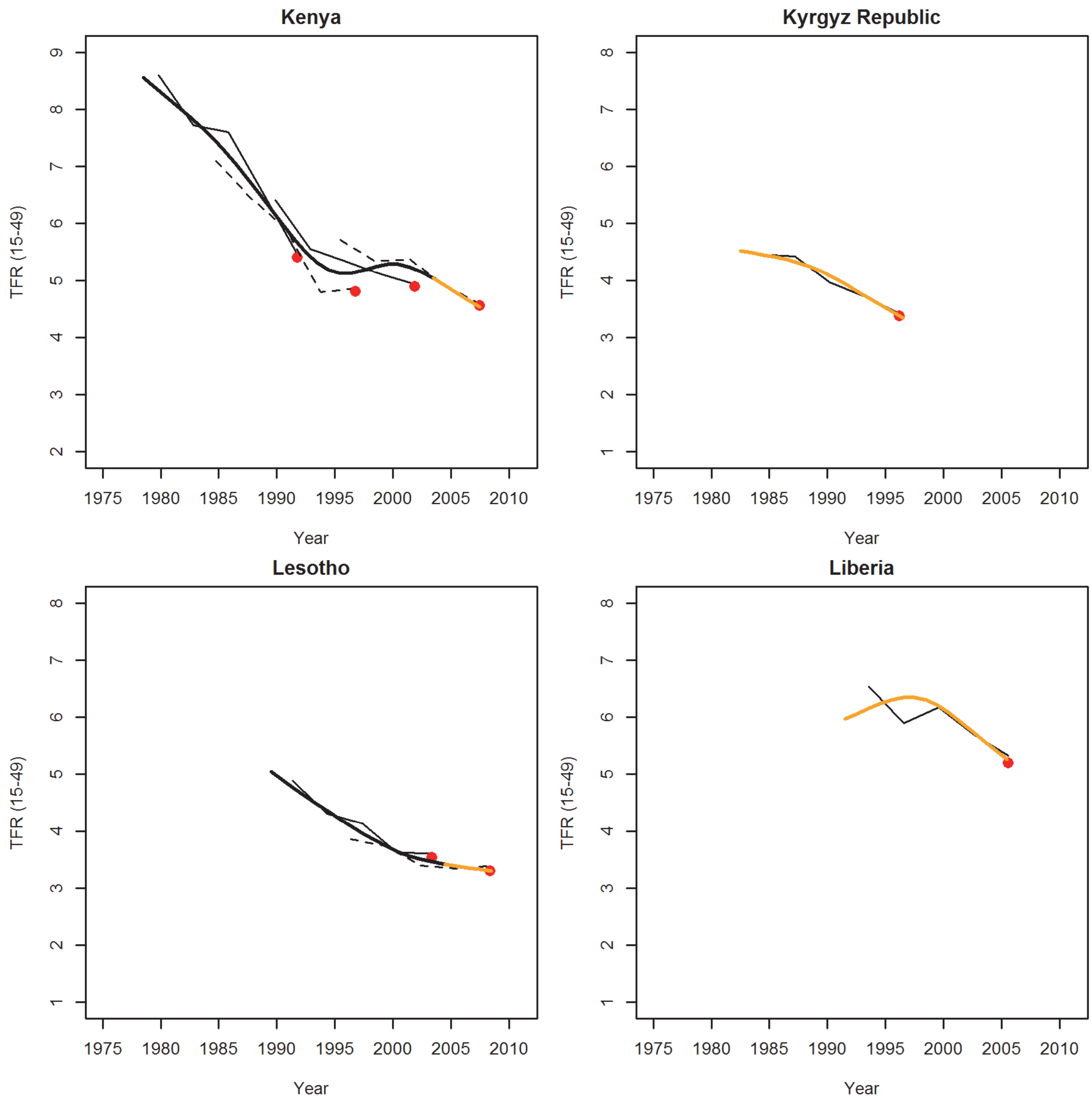

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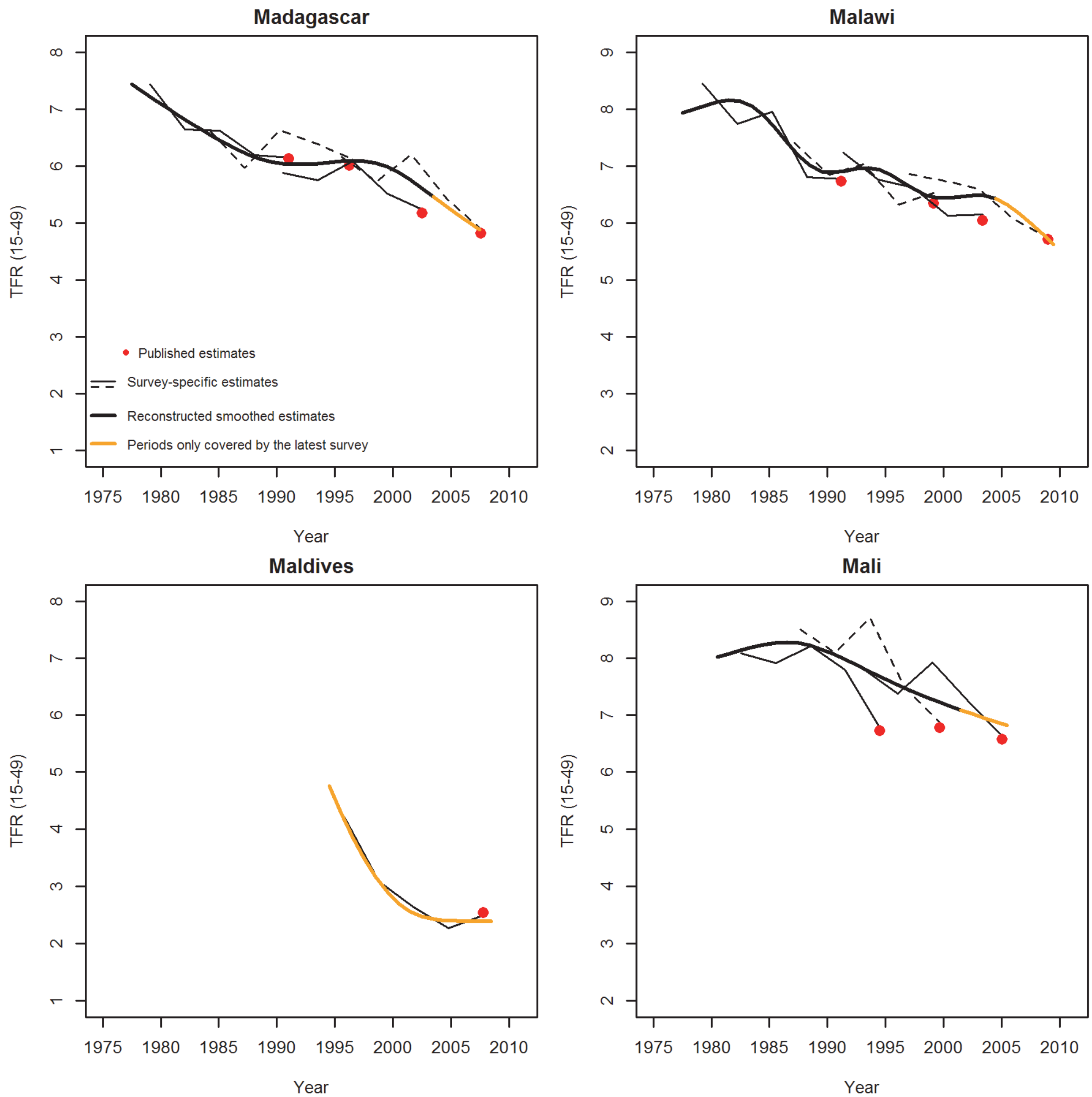

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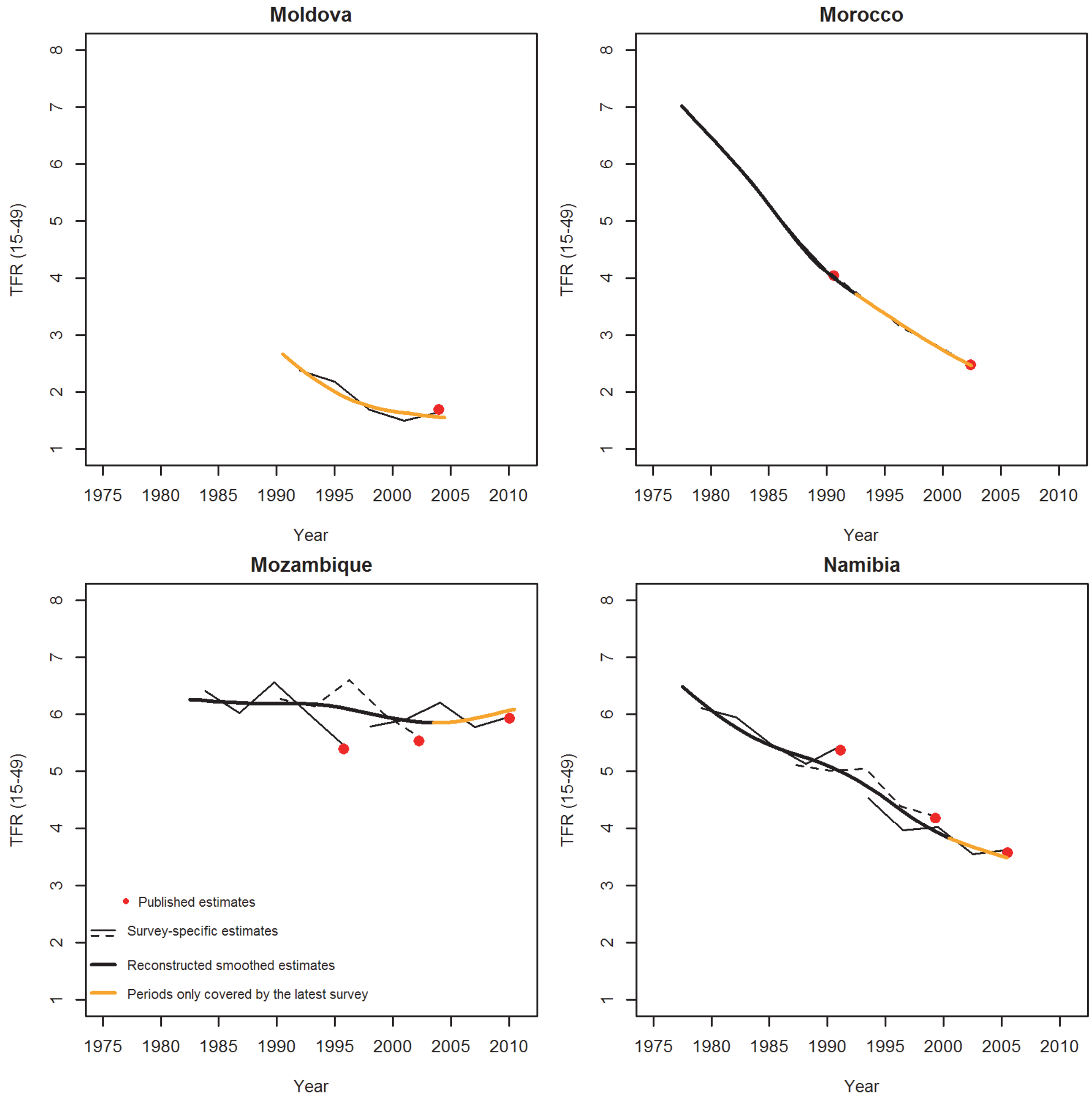

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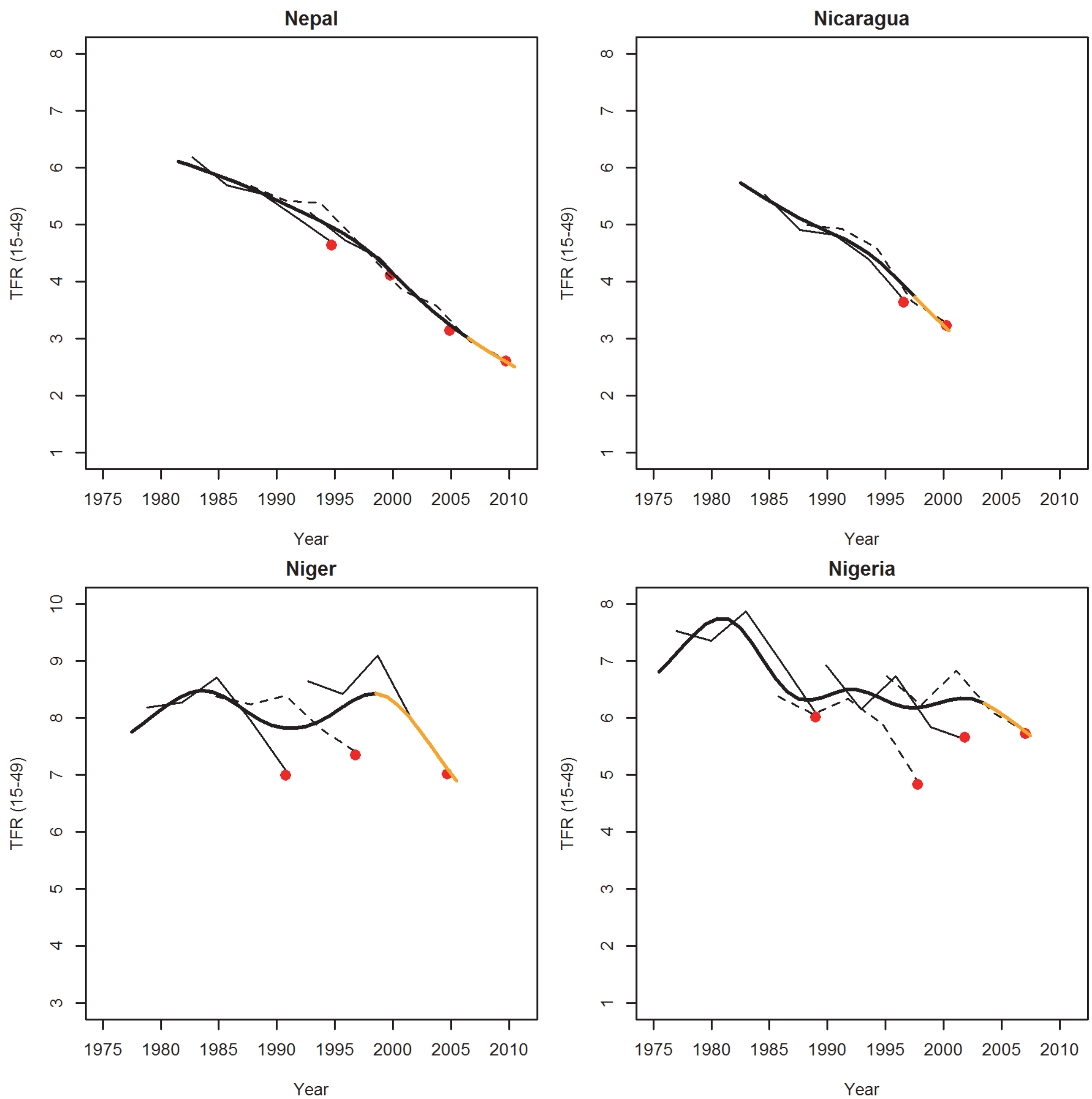

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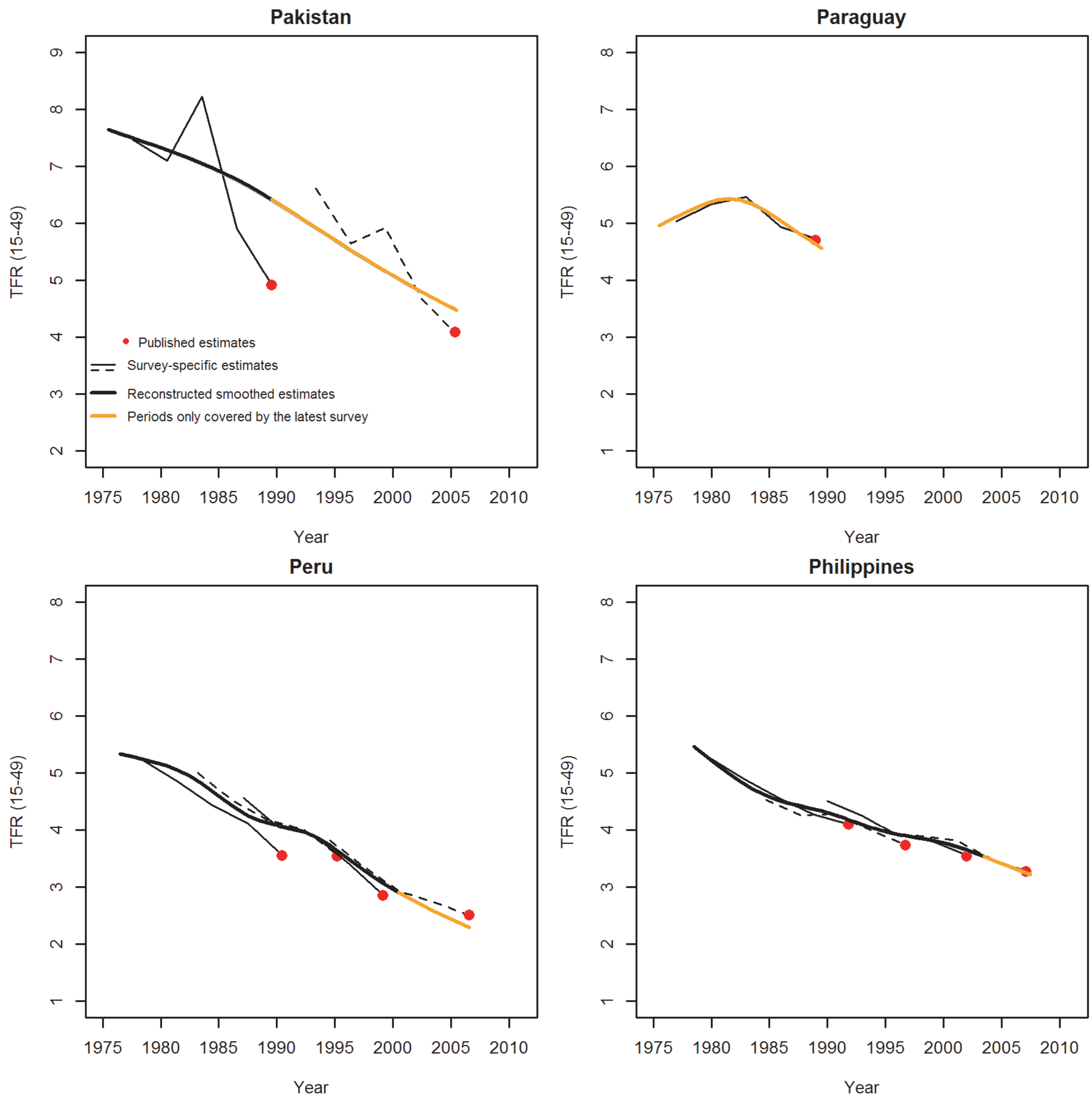

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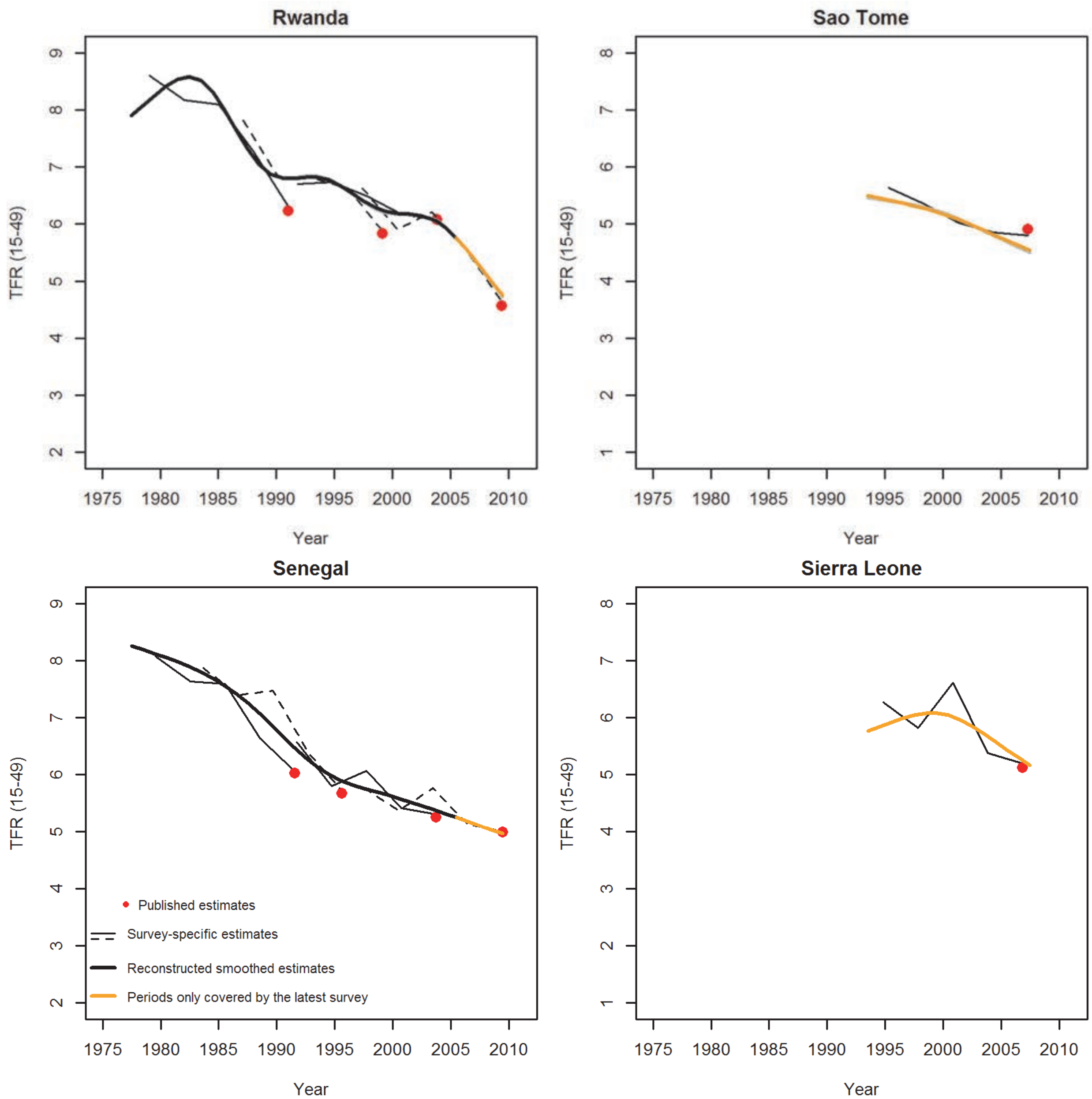

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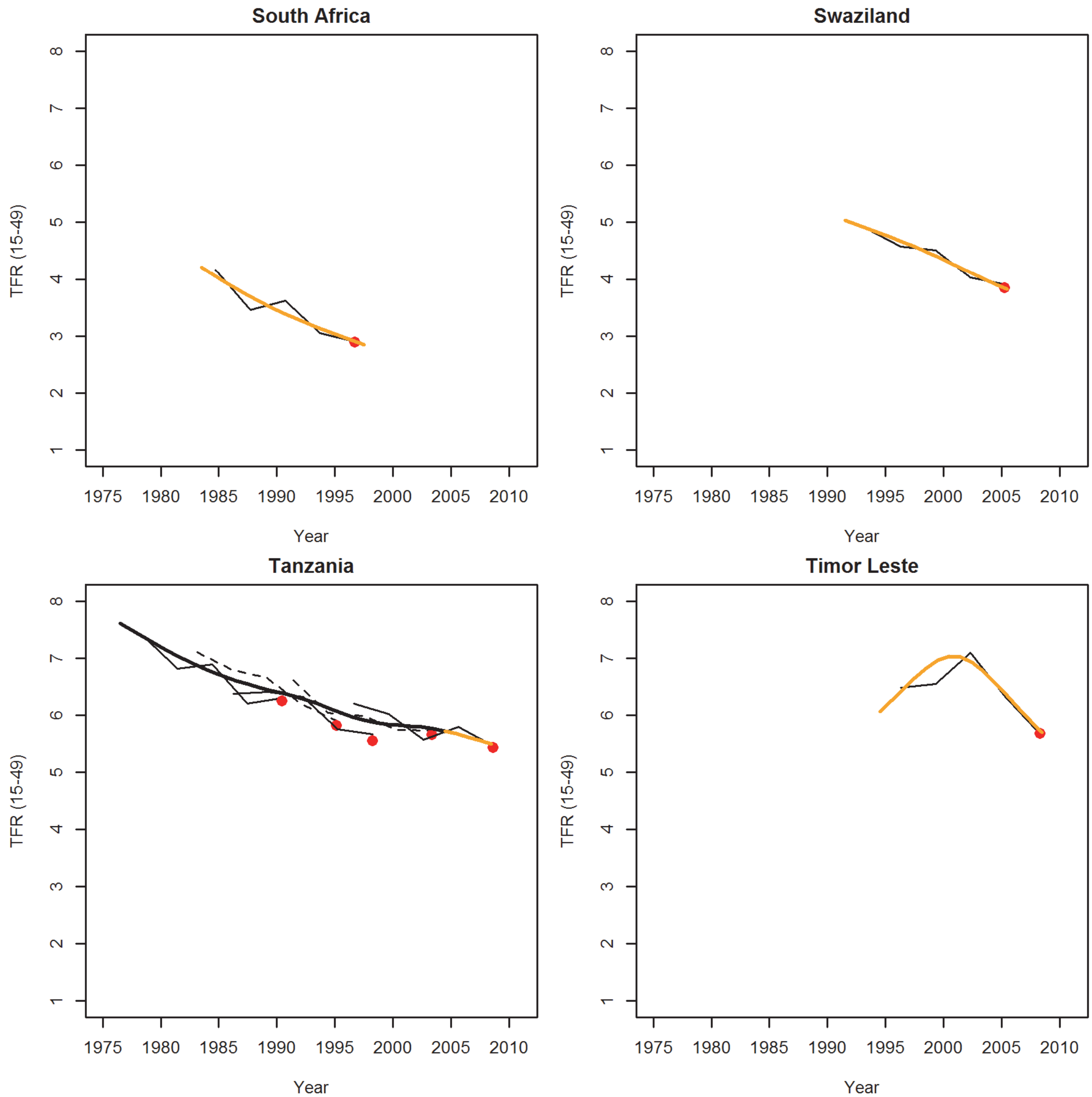

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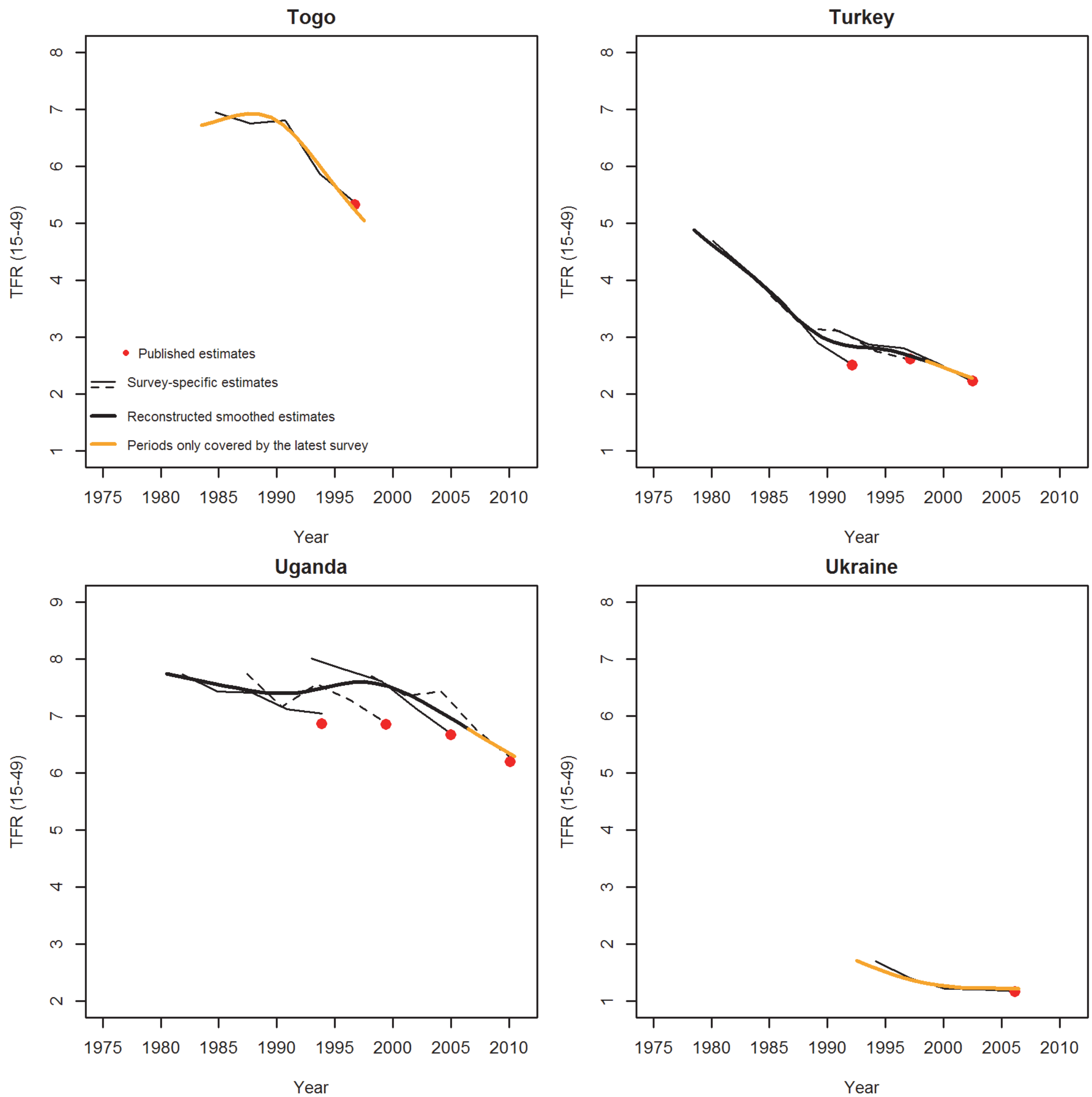

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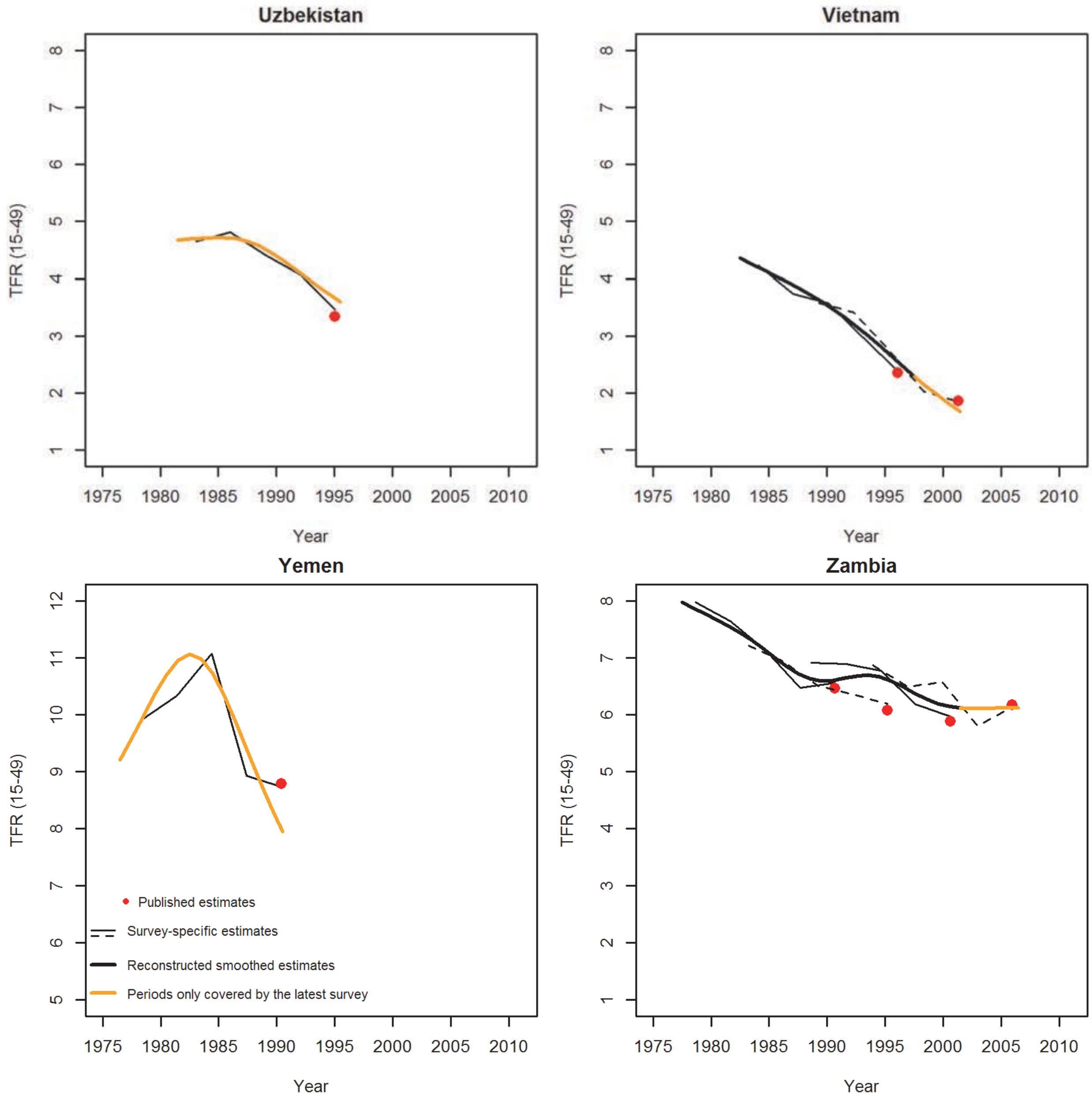

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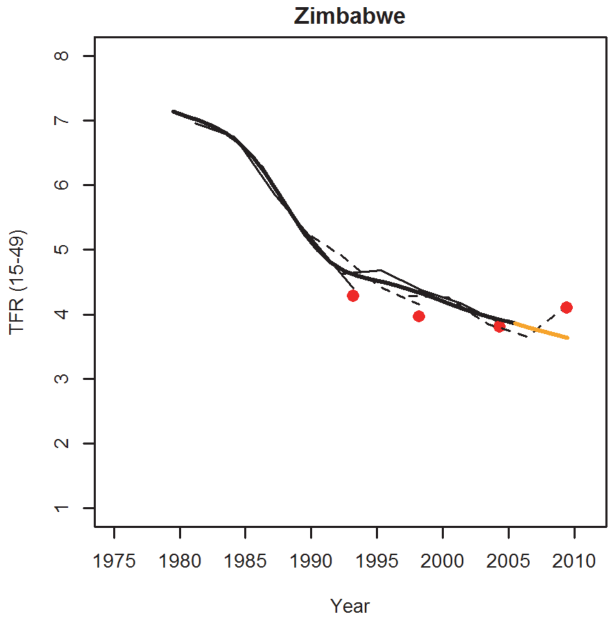
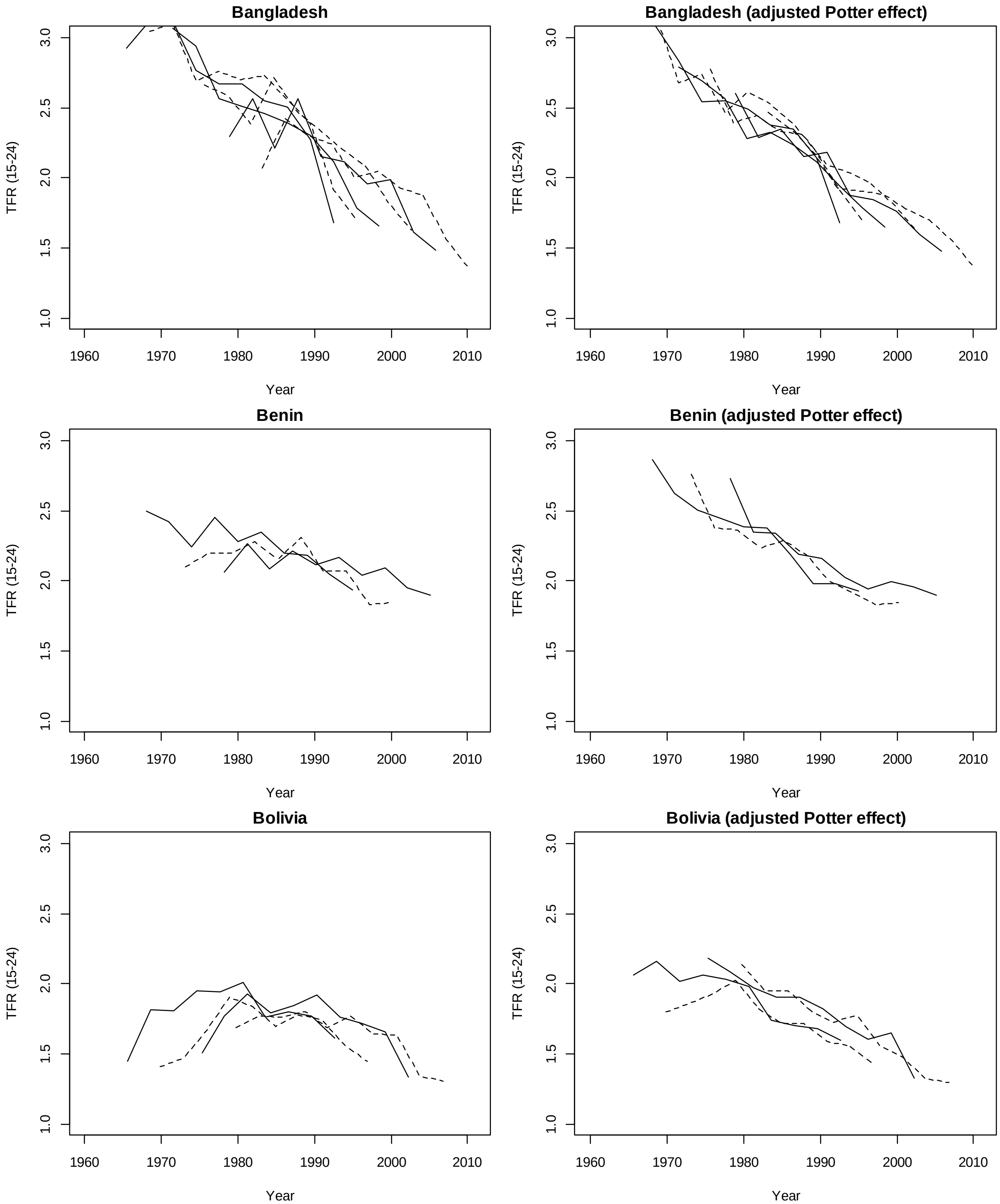


Appendix Figure A3. Reconstructed fertility trends (women 15-24) by three-year periods over the 30 years preceding each survey, with and without adjusting for a Potter effect (increase of birth intervals by 10 percent), in 18 countries (61 surveys)



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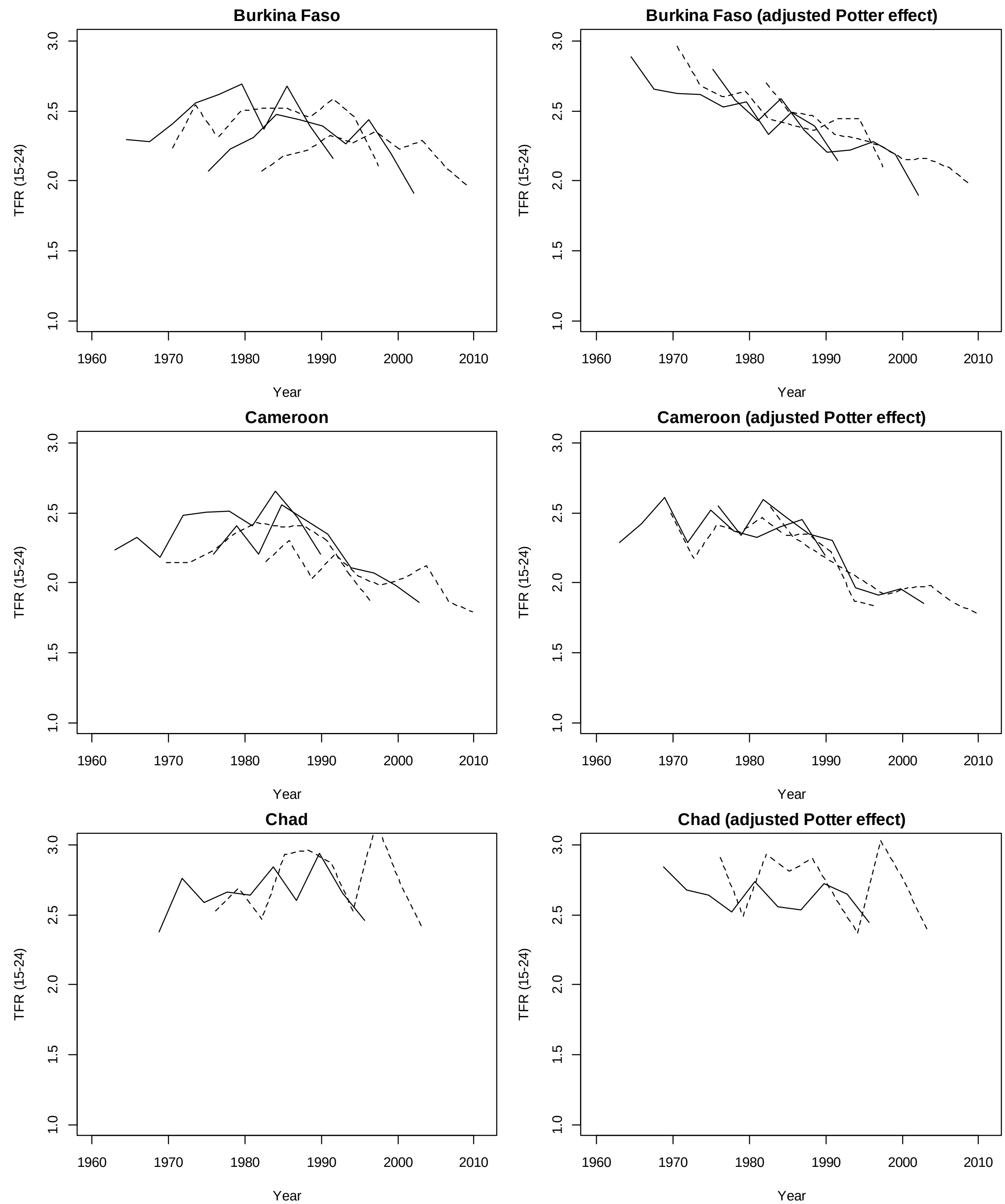

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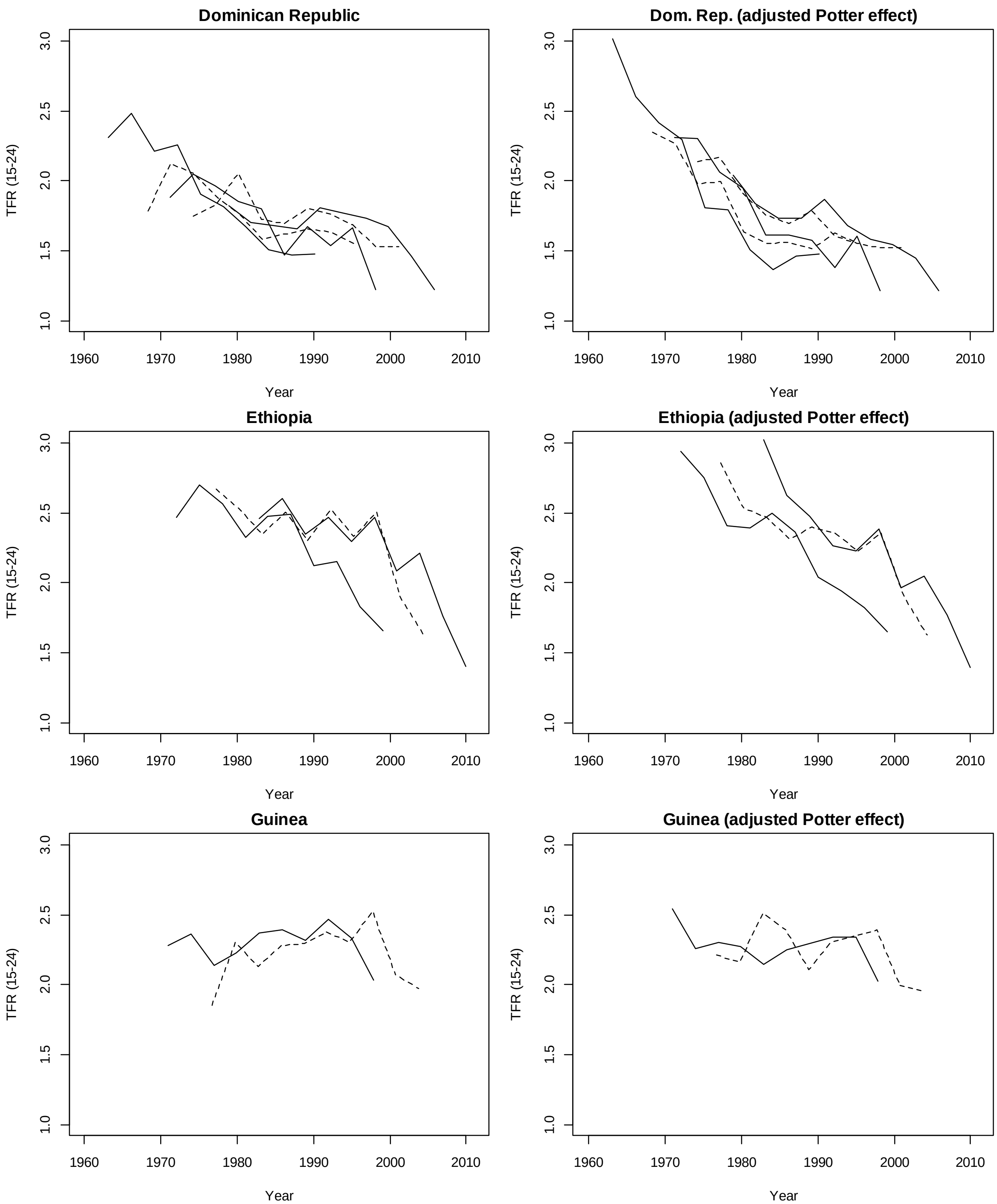

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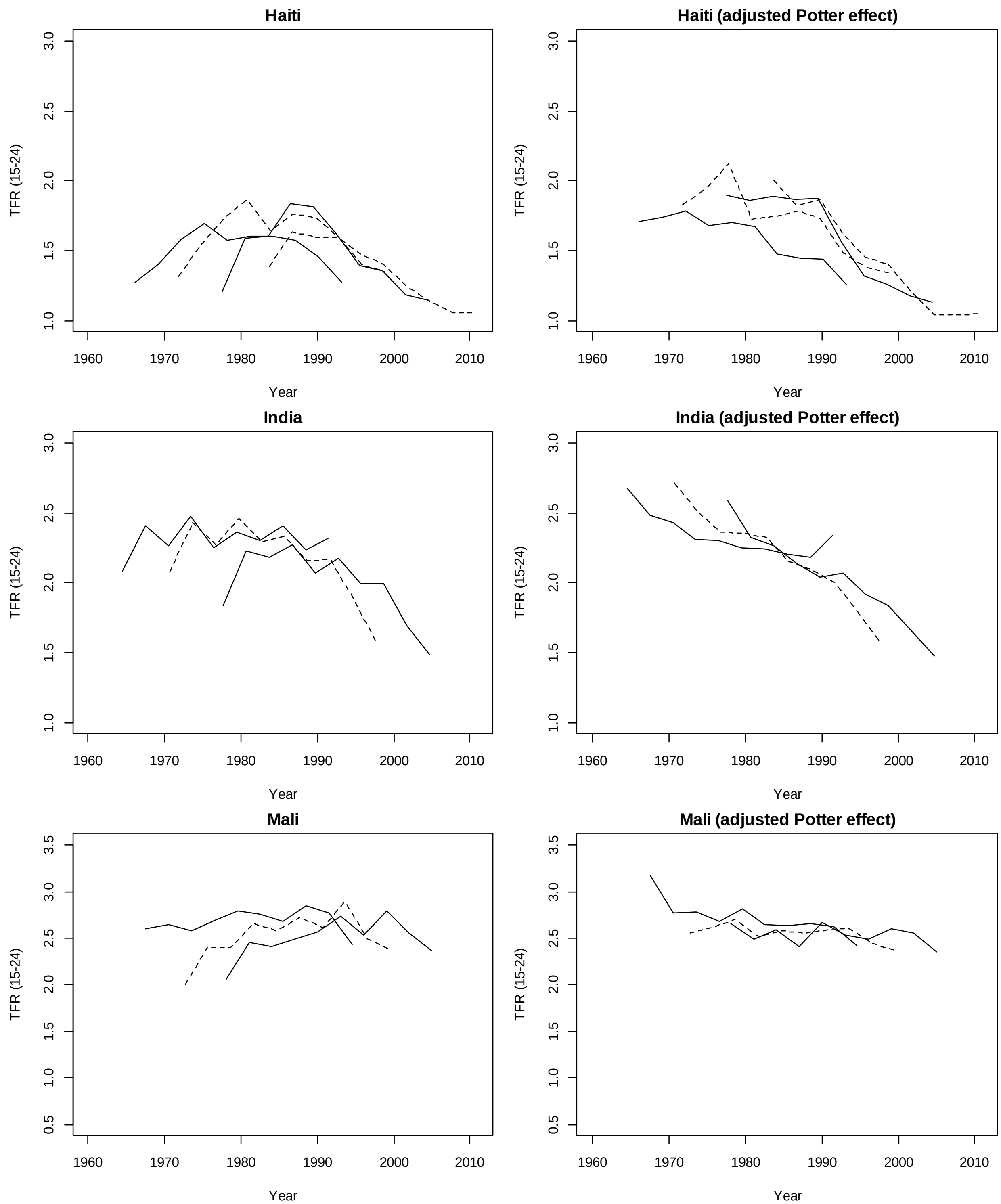

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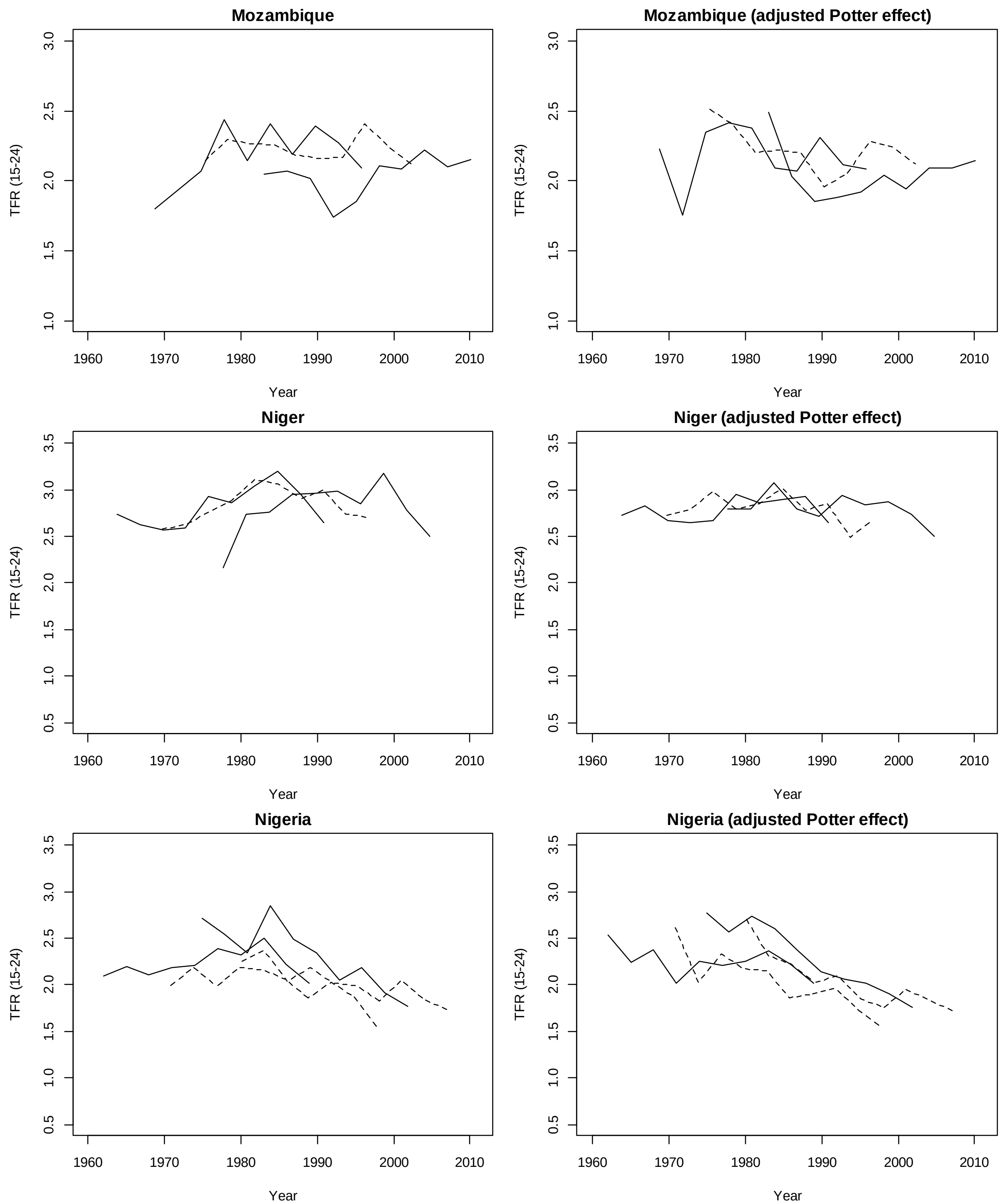

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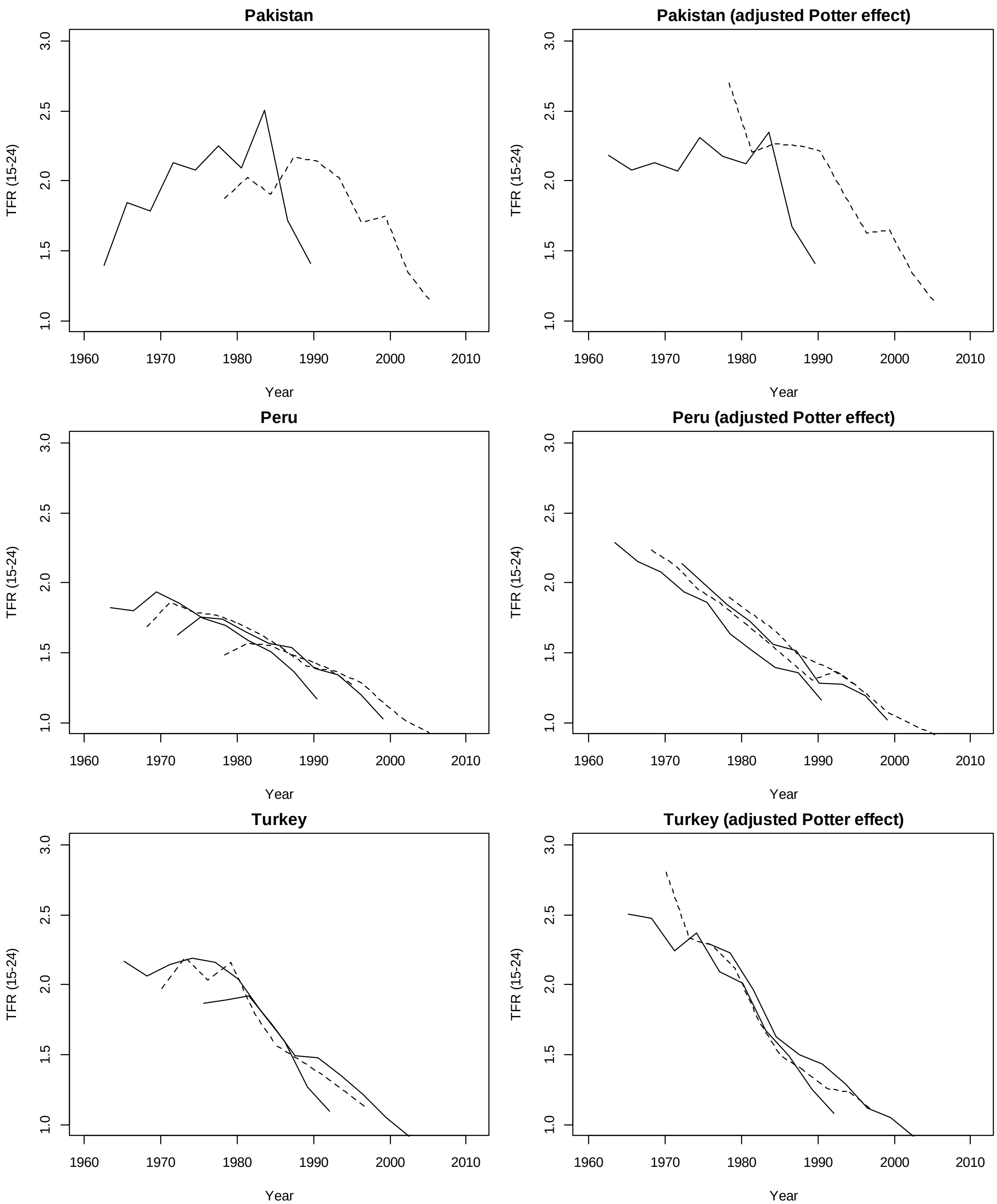
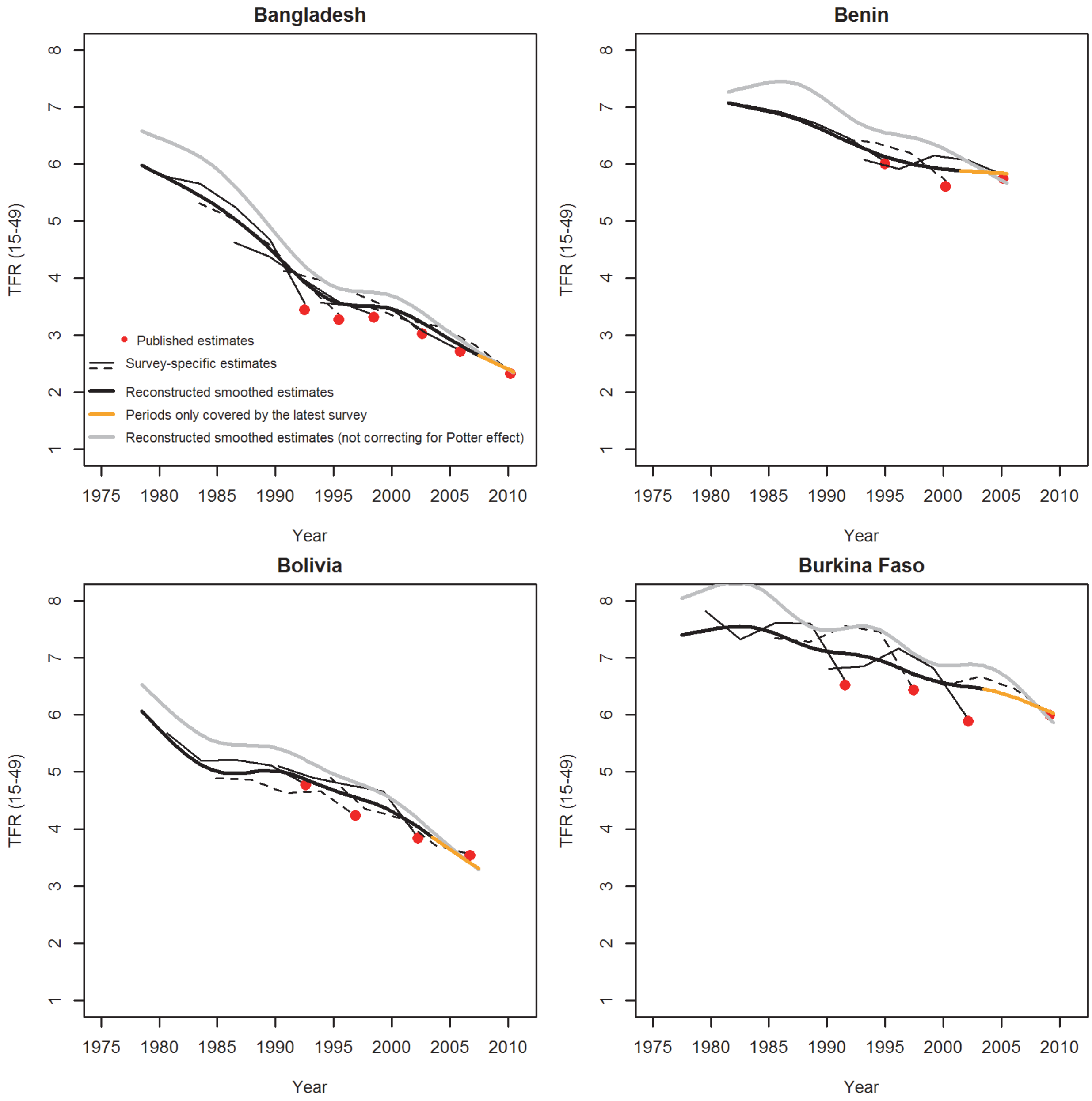


Appendix Figure A4. Reconstructed fertility trends (TFR 15-49) by three-year periods preceding each survey, published fertility (last three years), and reconstructed fertility with pooled birth histories with (black thick line) and without (grey thick line) correction for the Potter effect, 18 countries (61 surveys)



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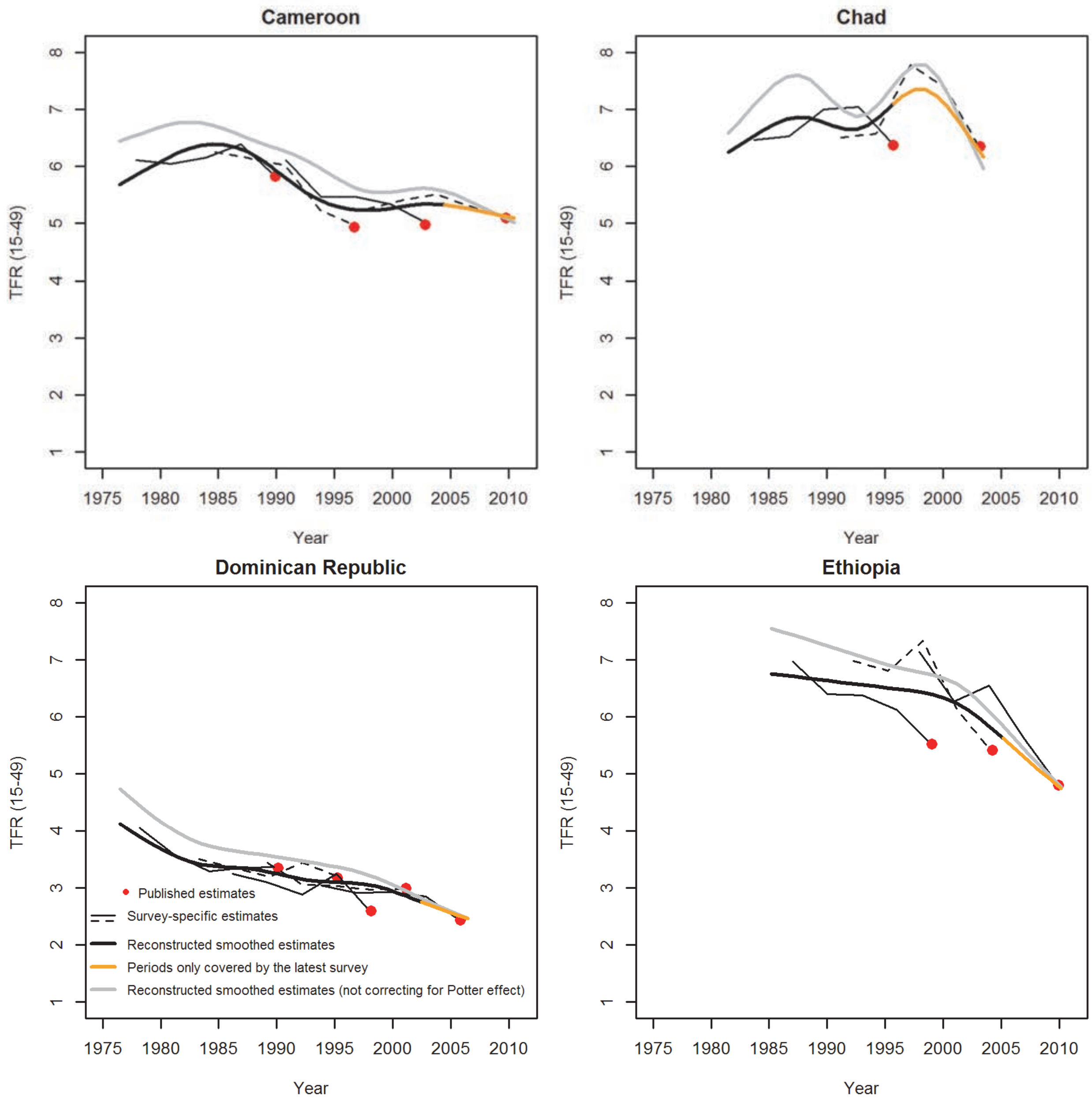

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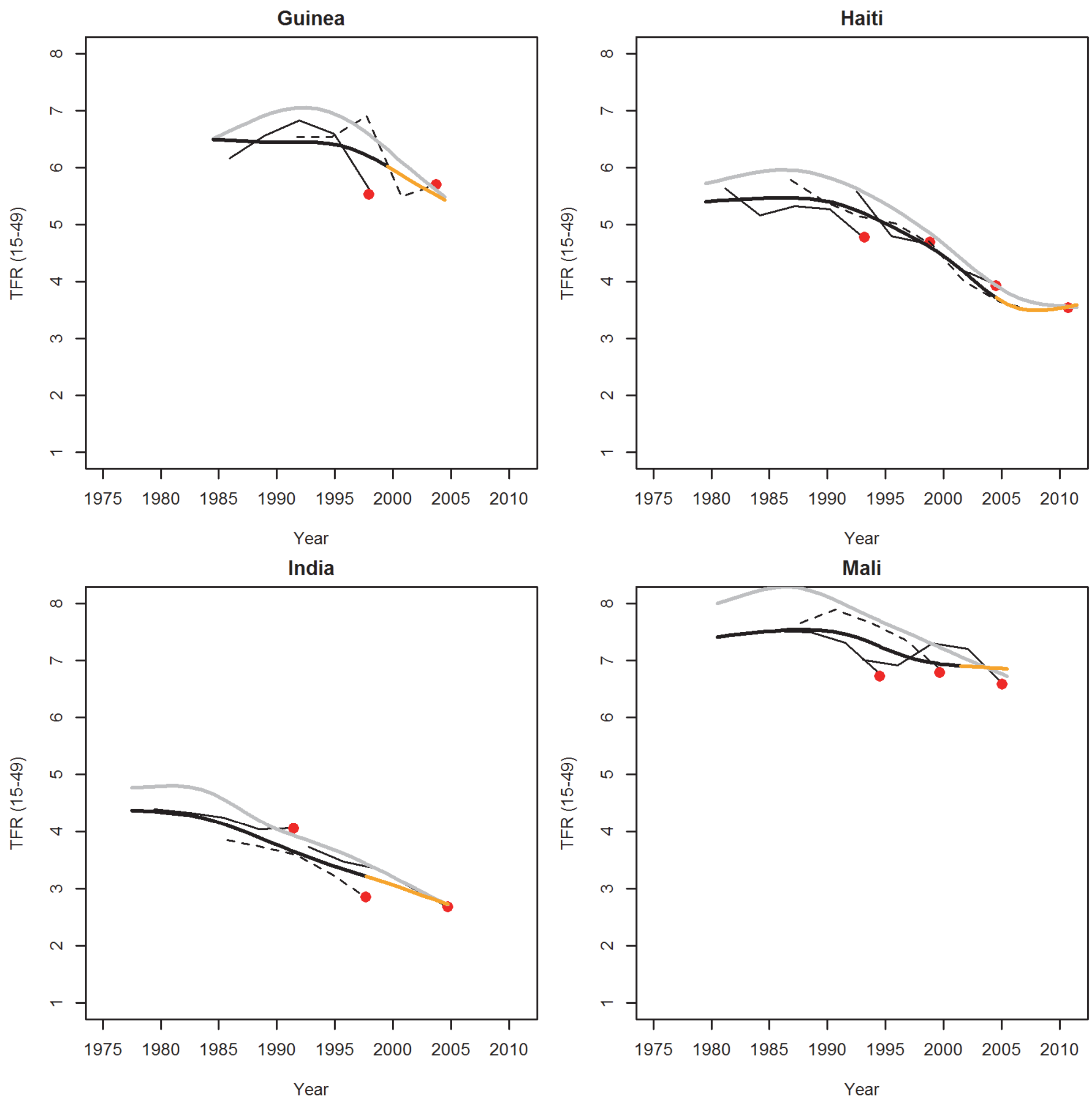

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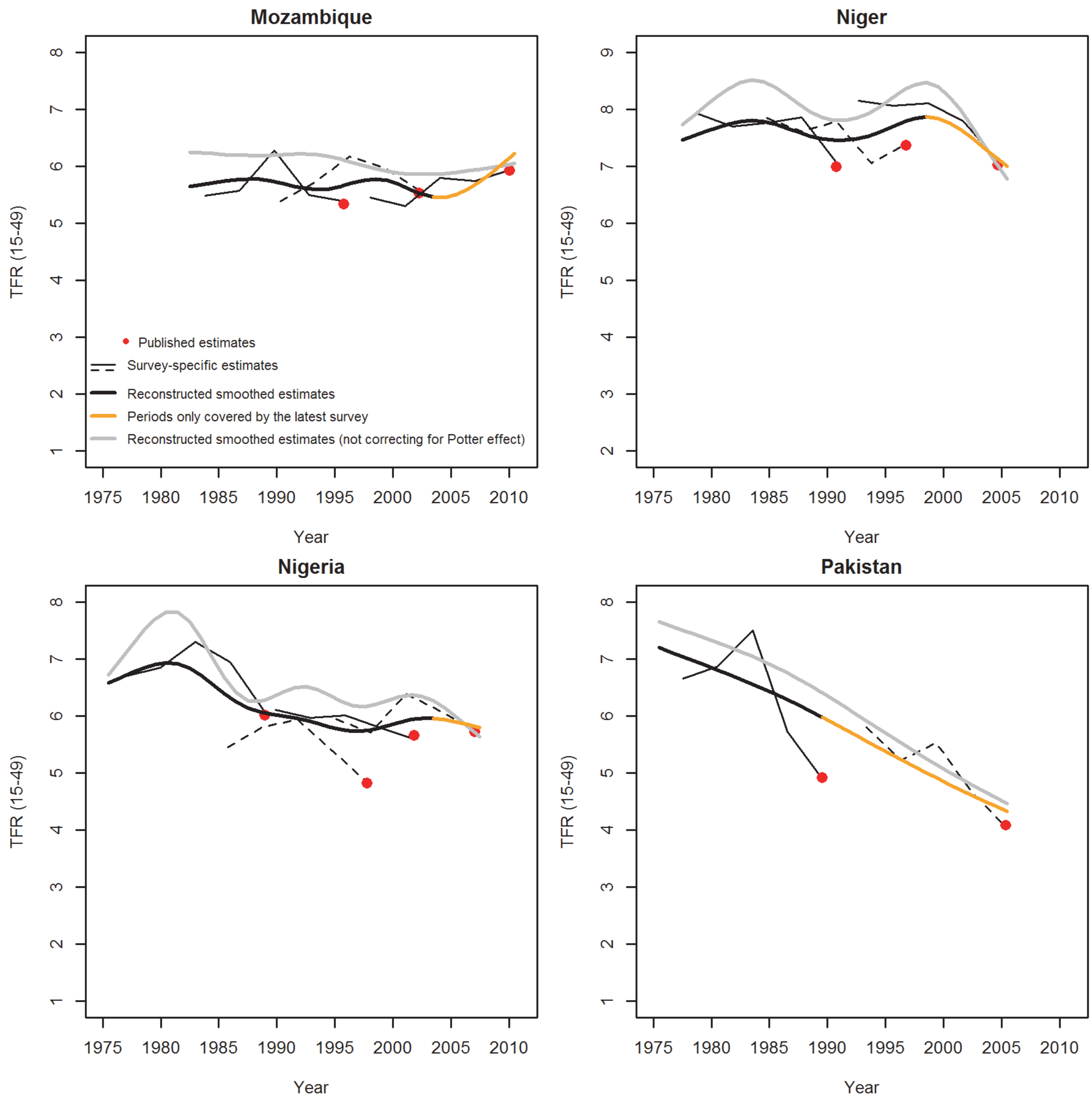

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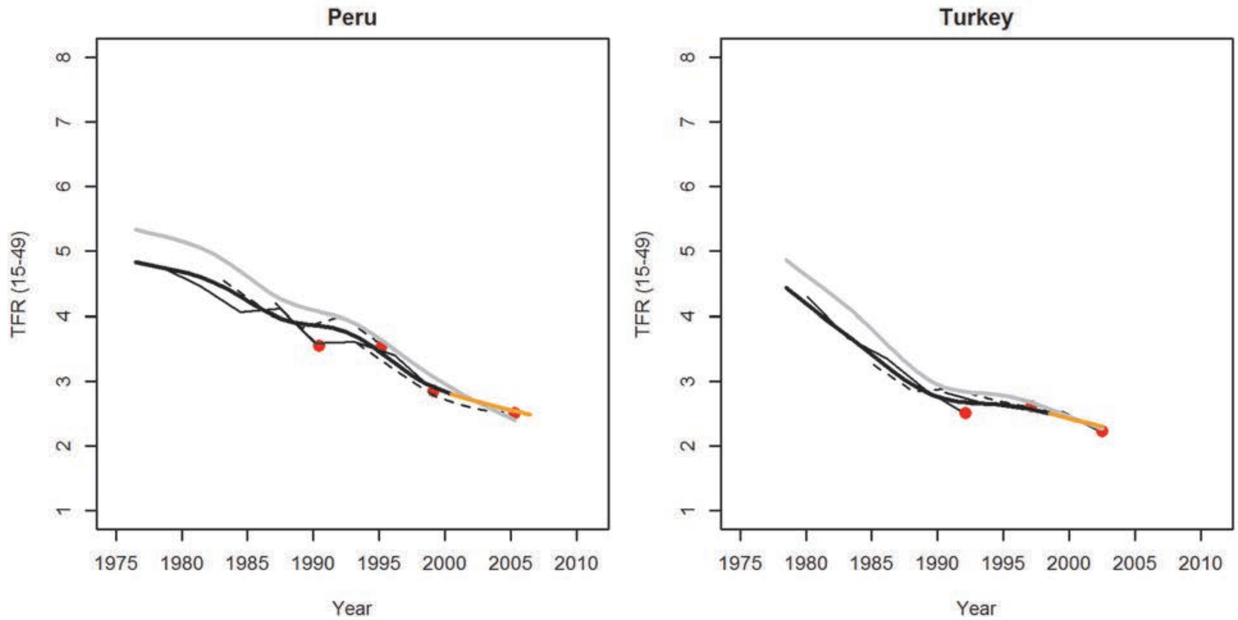
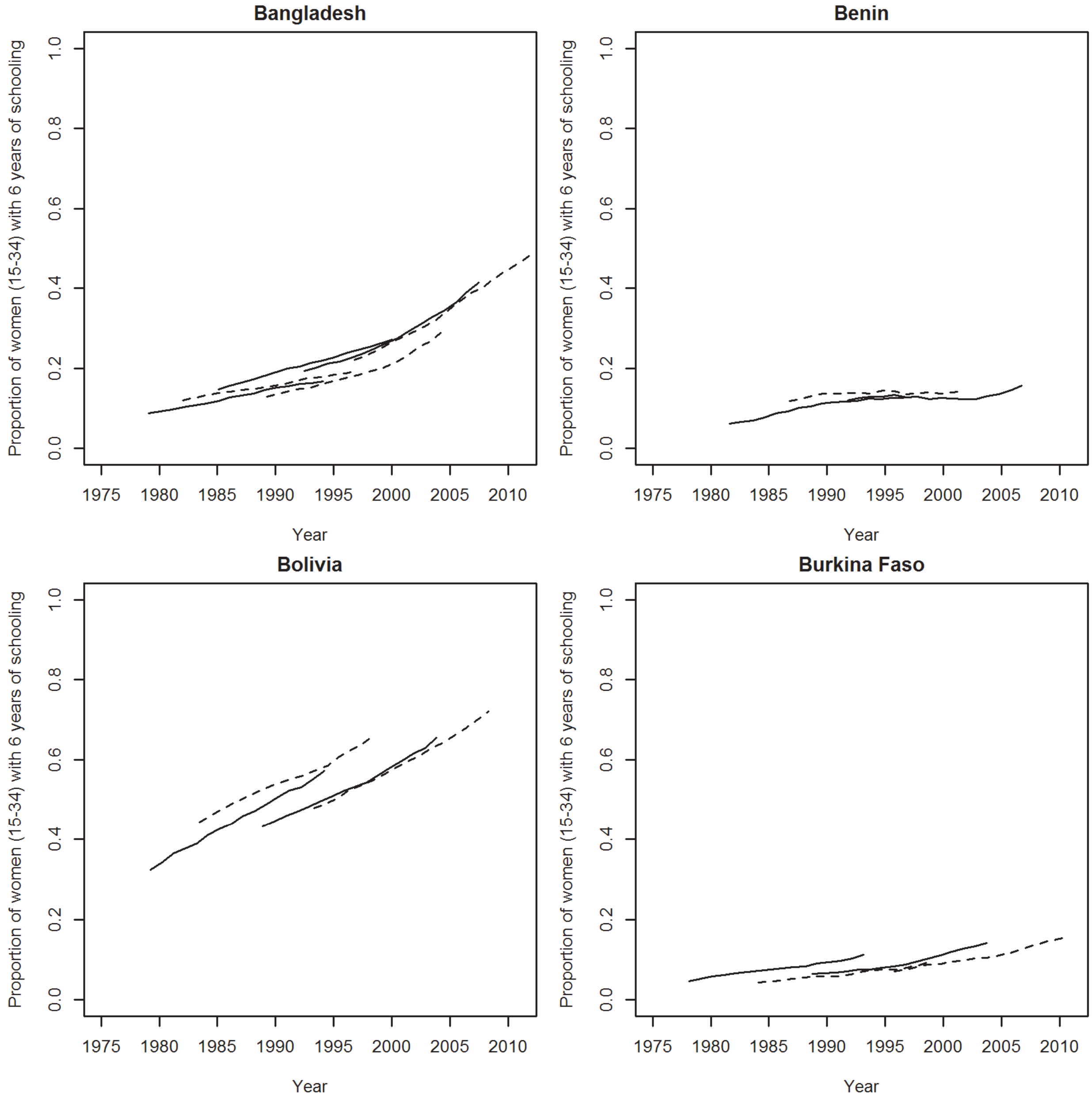


Appendix Figure A5. Comparison across surveys of the percentage of women (15-34) who have completed at least six years of education, reconstructed for the 15 years preceding each survey, 18 countries (61 surveys)



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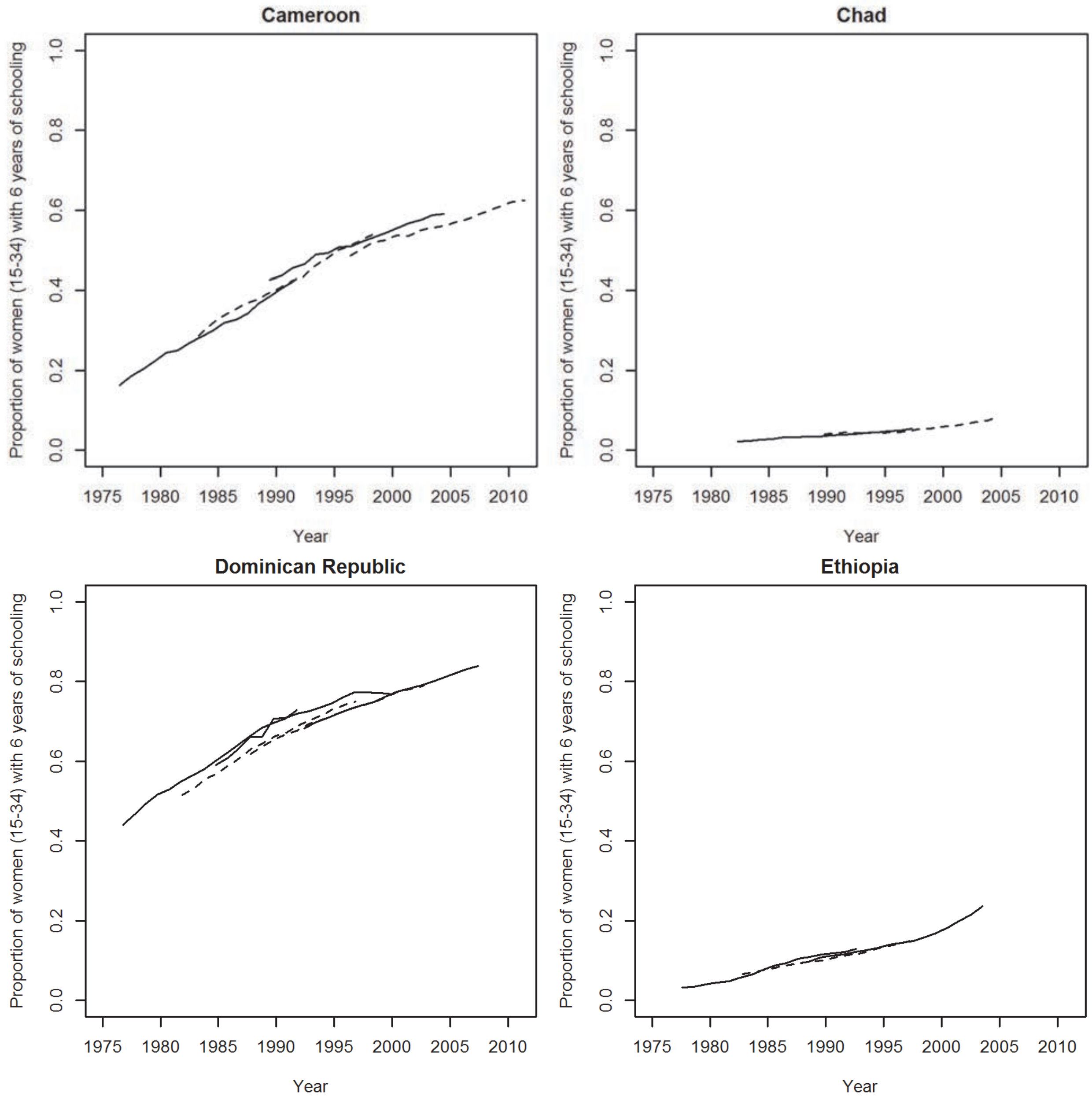

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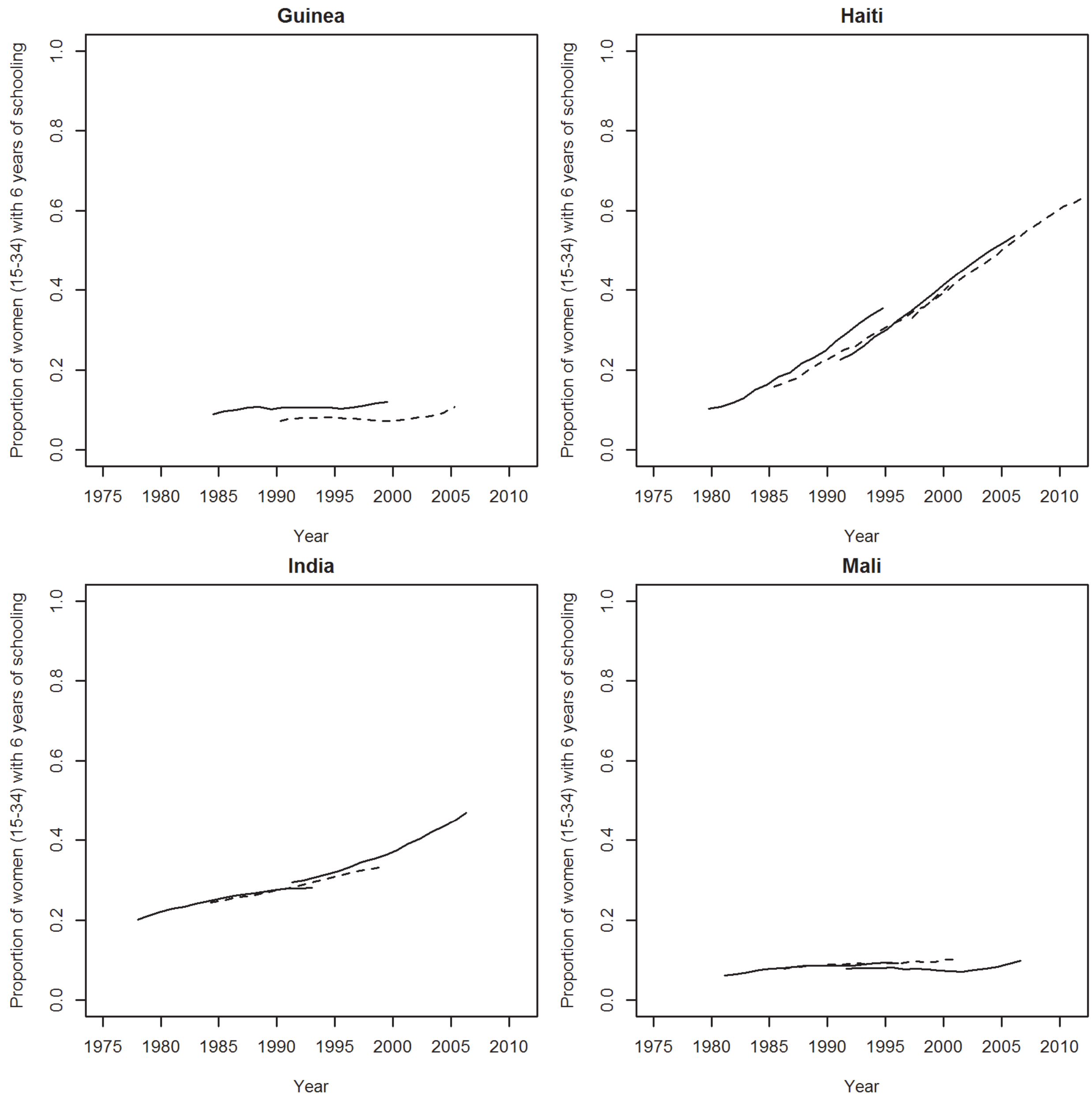

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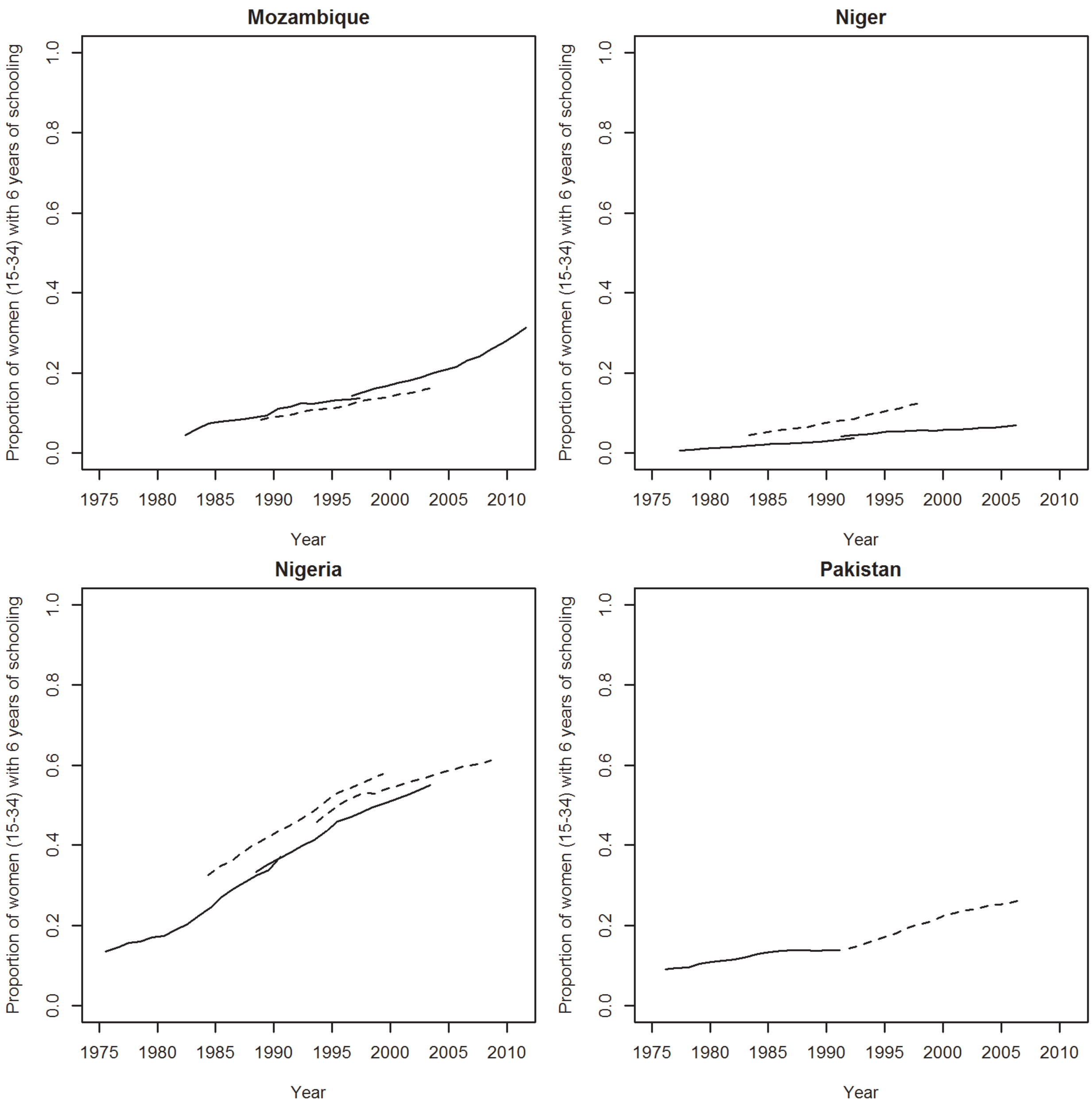

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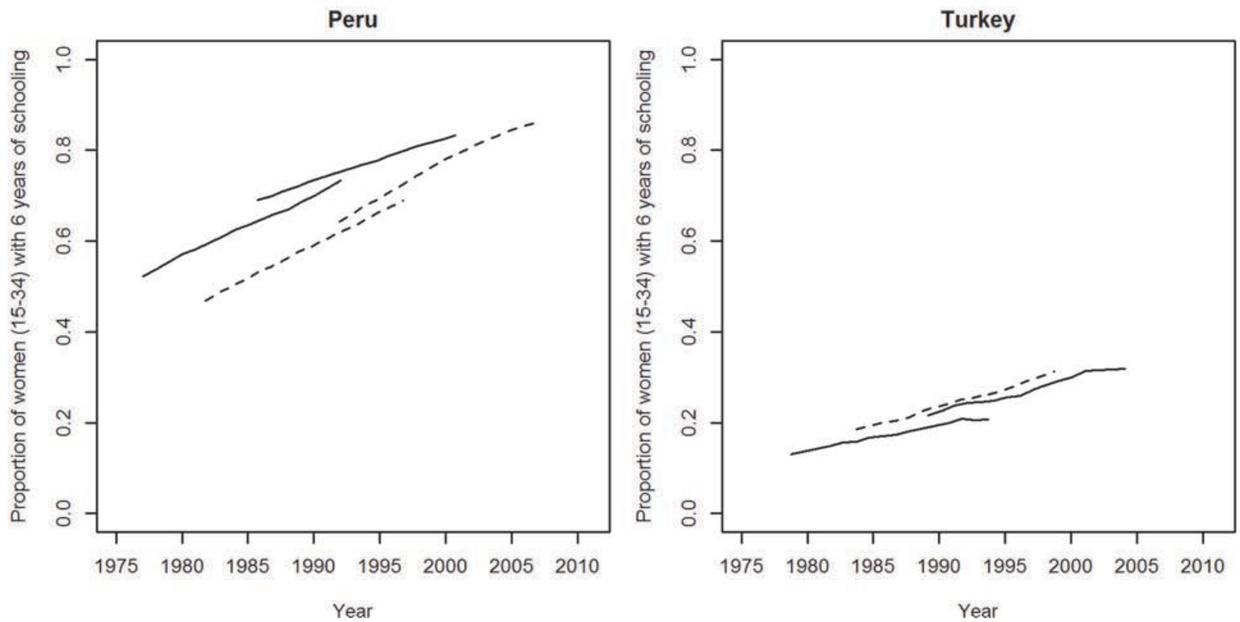

Appendix Table A1. Description of the 182 DHS surveys (1990-2012) used in this report

Survey	Region	Phase	Year	Reference period (months)	Published TFR (last 3 years)	Displacement index	Actual difference between published TFR and reconstructed TFR	Relative difference between published TFR and reconstructed TFR
Albania DHS-V	Europe	5	2008-09	72	1.59	-0.01		
Armenia DHS-IV	Europe	4	2000	69	1.71	0.07	-0.10	-0.06
Armenia DHS-V	Europe	5	2005	68	1.71	0.00	0.15	0.10
Armenia DHS-VI	Europe	6	2010	69	1.70	0.08		
Azerbaijan DHS-V	Europe	5	2006	67	2.02	0.08		
Bangladesh DHS-III	Asia	3	1993-94	44	3.44	-0.02	-0.78	-0.18
Bangladesh DHS-III	Asia	3	1996-97	68	3.27	0.06	-0.55	-0.14
Bangladesh DHS-IV	Asia	4	1999-2000	68	3.31	0.01	-0.37	-0.11
Bangladesh DHS-IV	Asia	4	2004	68	3.03	-0.04	-0.44	-0.12
Bangladesh DHS-V	Asia	5	2007	64	2.71	0.02	-0.21	-0.07
Bangladesh DHS-VI	Asia	6	2011	68	2.32	0.04		
Benin DHS-III	Sub-Saharan Africa	3	1996	42	5.96	0.03	-0.60	-0.09
Benin DHS-IV	Sub-Saharan Africa	4	2001	68	5.61	0.10	-0.65	-0.10
Benin DHS-V	Sub-Saharan Africa	5	2006	68	5.74	0.18		
Bolivia DHS-III	Latin America	3	1994	49	4.77	0.08	-0.44	-0.08
Bolivia DHS-III	Latin America	3	1998	64	4.23	0.07	-0.58	-0.12
Bolivia DHS-IV	Latin America	4	2003	69	3.84	0.05	-0.34	-0.08
Bolivia DHS-V	Latin America	5	2008	62	3.54	0.05		
Brazil DHS-II	Latin America	2	1991	69	3.65	0.01	0.51	0.16
Brazil DHS-III	Latin America	3	1996	63	2.54	0.02		
Burkina Faso DHS-II	Sub-Saharan Africa	2	1993	72	6.52	0.17	-1.00	-0.13
Burkina Faso DHS-III	Sub-Saharan Africa	3	1998-99	71	6.43	0.13	-0.63	-0.09
Burkina Faso DHS-IV	Sub-Saharan Africa	4	2003	67	5.88	0.14	-0.99	-0.14
Burkina Faso DHS-VI	Sub-Saharan Africa	6	2010	68	5.99	0.13		
Burundi DHS-VI	Sub-Saharan Africa	6	2010	69	6.38	0.04		

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Appendix Table A1. – *Continued*

Survey	Region	Phase	Year	Reference period (months)	Published TFR (last 3 years)	Displacement index	Actual difference between published TFR and reconstructed TFR	Relative difference between published TFR and reconstructed TFR
Cambodia DHS-IV	Asia	4	2000	63	3.77	0.20	-0.26	-0.06
Cambodia DHS-V	Asia	5	2005	70	3.40	-0.02	0.01	0.00
Cambodia DHS-VI	Asia	6	2010	68	3.04	0.06		
Cameroon DHS-II	Sub-Saharan Africa	2	1991	65	5.82	0.08	-0.50	-0.08
Cameroon DHS-III	Sub-Saharan Africa	3	1998	38	4.81	0.10	-0.82	-0.14
Cameroon DHS-IV	Sub-Saharan Africa	4	2004	64	4.97	0.11	-0.65	-0.12
Cameroon DHS-VI	Sub-Saharan Africa	6	2011	75	5.09	0.12		
Central African Republic DHS-III	Sub-Saharan Africa	3	1994-95	46	5.07	0.07		
Chad DHS-III	Sub-Saharan Africa	3	1996-97	74	6.37	0.19	-1.05	-0.14
Chad DHS-IV	Sub-Saharan Africa	4	2004	68	6.34	0.18		
Colombia DHS-II	Latin America	2	1990	65	2.82	0.00	-0.18	-0.06
Colombia DHS-III	Latin America	3	1995	63	2.97	0.05	-0.07	-0.02
Colombia DHS-IV	Latin America	4	2000	63	2.61	0.01	-0.15	-0.05
Colombia DHS-V	Latin America	5	2005	73	2.39	0.03	-0.04	-0.02
Colombia DHS-VI	Latin America	6	2010	66	2.14	0.01		
Comoros DHS-III	Sub-Saharan Africa	3	1996	39	4.65	0.12		
Congo (Brazzaville) DHS-V	Sub-Saharan Africa	5	2005	67	4.80	0.08		
Congo Democratic Republic DHS-V	Sub-Saharan Africa	5	2007	64	6.28	0.02		
Cote d'Ivoire DHS-III	Sub-Saharan Africa	3	1998-99	71	5.18	0.13	-0.45	-0.08
Cote d'Ivoire DHS-III	Sub-Saharan Africa	3	1994	43	5.30	0.15	-0.27	-0.05
Cote d'Ivoire DHS-VI	Sub-Saharan Africa	6	2011-12	72	4.96	0.17		
Dominican Republic DHS-II	Latin America	2	1991	68	3.34	0.06	-0.19	-0.05
Dominican Republic DHS-III	Latin America	3	1996	69	3.17	0.03	-0.19	-0.06
Dominican Republic DHS-IV	Latin America	4	1999	44	2.66	-0.07	-0.54	-0.17

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Appendix Table A1. – *Continued*

Survey	Region	Phase	Year	Reference period (months)	Published TFR (last 3 years)	Displacement index	Actual difference between published TFR and reconstructed TFR	Relative difference between published TFR and reconstructed TFR
Dominican Republic DHS-IV	Latin America	4	2002	68	2.99	-0.01	0.04	0.01
Dominican Republic DHS-V	Latin America	5	2007	64	2.43	0.02		
Egypt DHS-II	MENA	2	1992	70	3.93	0.05	-0.27	-0.06
Egypt DHS-III	MENA	3	1995	70	3.63	0.04	-0.10	-0.03
Egypt DHS-IV	MENA	4	2000	61	3.53	0.12	-0.10	-0.03
Egypt DHS-V	MENA	5	2005	64	3.13	0.08	-0.07	-0.02
Egypt DHS-V	MENA	5	2008	63	3.02	0.15		
Ethiopia DHS-IV	Sub-Saharan Africa	4	2000	66	5.52	-0.04	-1.23	-0.18
Ethiopia DHS-V	Sub-Saharan Africa	5	2005	69	5.41	0.05	-0.70	-0.11
Ethiopia DHS-VI	Sub-Saharan Africa	6	2011	65	4.80	-0.09		
Gabon DHS-IV	Sub-Saharan Africa	4	2000	68	4.21	0.09	-0.10	-0.02
Gabon DHS-VI	Sub-Saharan Africa	6	2012	61	4.10	0.06		
Ghana DHS-III	Sub-Saharan Africa	3	1993	45	5.16	0.23	-0.17	-0.03
Ghana DHS-IV	Sub-Saharan Africa	4	1998	71	4.44	0.08	-0.38	-0.08
Ghana DHS-IV	Sub-Saharan Africa	4	2003	67	4.45	0.13	-0.14	-0.03
Ghana DHS-V	Sub-Saharan Africa	5	2008	68	4.03	0.18		
Guatemala DHS-III	Latin America	3	1995	68	5.13	0.07		
Guinea DHS-IV	Sub-Saharan Africa	4	1999	65	5.53	0.05	-1.05	-0.16
Guinea DHS-V	Sub-Saharan Africa	5	2005	62	5.71	0.14		
Guyana DHS-V	Latin America	5	2009	63	2.78	0.00		
Haiti DHS-III	Latin America	3	1994-95	68	4.78	0.13	-0.79	-0.14
Haiti DHS-IV	Latin America	4	2000	63	4.69	0.05	-0.16	-0.03
Haiti DHS-V	Latin America	5	2005-06	72	3.92	0.08	-0.01	0.00
Haiti DHS-VI	Latin America	6	2012	62	3.53	0.05		
Honduras DHS-V	Latin America	5	2005-06	73	3.26	0.03	-0.06	-0.02

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Appendix Table A1. – *Continued*

Survey	Region	Phase	Year	Reference period (months)	Published TFR (last 3 years)	Displacement index	Actual difference between published TFR and reconstructed TFR	Relative difference between published TFR and reconstructed TFR
Honduras DHS-VI	Latin America	6	2011-12	72	2.94	0.04		
India DHS-II	Asia	2	1992-93	59	4.05	0.03	0.12	0.03
India DHS-IV	Asia	4	1998-99	50	2.85	0.02	-0.59	-0.17
India DHS-V	Asia	5	2005-06	62	2.68	0.02		
Indonesia DHS-II	Asia	2	1991	65	3.02	0.10	-0.15	-0.05
Indonesia DHS-III	Asia	3	1994	66	2.85	0.09	-0.15	-0.05
Indonesia DHS-III	Asia	3	1997	69	2.78	0.12	-0.08	-0.03
Indonesia DHS-IV	Asia	4	2002-03	71	2.57	0.18	-0.10	-0.04
Indonesia DHS-V	Asia	5	2007	66	2.59	0.06	0.01	0.00
Indonesia DHS-VI	Asia	6	2012	64	2.60	0.04		
Jordan DHS-II	MENA	2	1990	70	5.57	0.02	-0.04	-0.01
Jordan DHS-III	MENA	3	1997	66	4.35	0.01	-0.21	-0.05
Jordan DHS-IV	MENA	4	2002	66	3.67	0.07	-0.24	-0.06
Jordan DHS-V	MENA	5	2007	66	3.59	0.04		
Kazakhstan DHS-III	Asia	3	1995	41	2.49	0.04	-0.06	-0.03
Kazakhstan DHS-IV	Asia	4	1999	66	2.05	0.00		
Kenya DHS-III	Sub-Saharan Africa	3	1993	63	5.40	0.08	-0.24	-0.04
Kenya DHS-III	Sub-Saharan Africa	3	1998	39	4.70	0.07	-0.44	-0.09
Kenya DHS-IV	Sub-Saharan Africa	4	2003	64	4.88	0.04	-0.32	-0.06
Kenya DHS-V	Sub-Saharan Africa	5	2008-09	71	4.56	0.17		
Kyrgyz Republic DHS-III	Asia	3	1997	44	3.37	0.06		
Lesotho DHS-IV	Sub-Saharan Africa	4	2004	70	3.54	0.04	0.08	0.02
Lesotho DHS-VI	Sub-Saharan Africa	6	2009	70	3.30	0.08		
Liberia DHS-V	Sub-Saharan Africa	5	2007	73	5.20	0.21		
Madagascar DHS-II	Sub-Saharan Africa	2	1992	66	6.13	0.09	0.10	0.02

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Appendix Table A1. – *Continued*

Survey	Region	Phase	Year	Reference period (months)	Published TFR (last 3 years)	Displacement index	Actual difference between published TFR and reconstructed TFR	Relative difference between published TFR and reconstructed TFR
Madagascar DHS-III	Sub-Saharan Africa	3	1997	45	5.97	0.09	-0.14	-0.02
Madagascar DHS-IV	Sub-Saharan Africa	4	2003-04	72	5.17	0.17	-0.43	-0.08
Madagascar DHS-V	Sub-Saharan Africa	5	2008-09	72	4.82	0.18		
Malawi DHS-II	Sub-Saharan Africa	2	1992	68	6.73	0.08	-0.19	-0.03
Malawi DHS-IV	Sub-Saharan Africa	4	2000	67	6.35	0.22	-0.07	-0.01
Malawi DHS-IV	Sub-Saharan Africa	4	2004	70	6.04	0.17	-0.45	-0.07
Malawi DHS-VI	Sub-Saharan Africa	6	2010	66	5.71	0.06		
Maldives DHS-V	Asia	5	2009	75	2.54	0.06		
Mali DHS-III	Sub-Saharan Africa	3	1995-96	48	6.71	0.07	-0.98	-0.13
Mali DHS-IV	Sub-Saharan Africa	4	2001	62	6.78	0.09	-0.45	-0.06
Mali DHS-V	Sub-Saharan Africa	5	2006	66	6.58	0.25		
Moldova DHS-V	Europe	5	2005	65	1.69	-0.02		
Morocco DHS-II	MENA	2	1992	73	4.04	0.00	0.04	0.01
Morocco DHS-IV	MENA	4	2003-04	70	2.48	0.04		
Mozambique DHS-III	Sub-Saharan Africa	3	1997	39	5.17	0.17	-0.94	-0.15
Mozambique DHS-IV	Sub-Saharan Africa	4	2003	69	5.53	0.12	-0.33	-0.06
Mozambique DHS-VI	Sub-Saharan Africa	6	2011	66	5.92	0.08		
Namibia DHS-II	Sub-Saharan Africa	2	1992	67	5.37	0.05	0.37	0.07
Namibia DHS-IV	Sub-Saharan Africa	4	2000	69	4.18	0.09	0.25	0.06
Namibia DHS-V	Sub-Saharan Africa	5	2006-07	72	3.57	0.10		
Nepal DHS-III	Asia	3	1996	46	4.64	0.01	-0.32	-0.06
Nepal DHS-IV	Asia	4	2001	71	4.11	0.01	-0.08	-0.02
Nepal DHS-V	Asia	5	2006	72	3.13	0.05	-0.11	-0.03
Nepal DHS-VI	Asia	6	2011	71	2.60	0.03		
Nicaragua DHS-III	Latin America	3	1998	73	3.63	-0.06	-0.30	-0.08

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Appendix Table A1. – *Continued*

Survey	Region	Phase	Year	Reference period (months)	Published TFR (last 3 years)	Displacement index	Actual difference between published TFR and reconstructed TFR	Relative difference between published TFR and reconstructed TFR
Nicaragua DHS-IV	Latin America	4	2001	69	3.23	0.10		
Niger DHS-II	Sub-Saharan Africa	2	1992	63	6.99	0.09	-0.81	-0.10
Niger DHS-III	Sub-Saharan Africa	3	1998	39	7.20	0.10	-1.16	-0.14
Niger DHS-V	Sub-Saharan Africa	5	2006	62	7.02	0.25		
Nigeria DHS-II	Sub-Saharan Africa	2	1990	65	6.01	0.20	-0.27	-0.04
Nigeria DHS-IV	Sub-Saharan Africa	4	1999	39	4.73	0.09	-1.45	-0.23
Nigeria DHS-IV	Sub-Saharan Africa	4	2003	64	5.66	-0.02	-0.71	-0.11
Nigeria DHS-V	Sub-Saharan Africa	5	2008	67	5.72	0.13		
Pakistan DHS-II	Asia	2	1990-91	60	4.91	0.25	-1.49	-0.23
Pakistan DHS-V	Asia	5	2006-07	70	4.08	0.11		
Paraguay DHS-II	Latin America	2	1990	65	4.71	-0.01		
Peru DHS-II	Latin America	2	1991-92	71	3.54	0.06	-0.52	-0.13
Peru DHS-III	Latin America	3	1996	68	3.54	0.09	-0.10	-0.03
Peru DHS-IV	Latin America	4	2000	67	2.85	0.06	-0.22	-0.07
Peru DHS-V	Latin America	5	2004-08	69	2.53	0.04		
Philippines DHS-III	Asia	3	1993	64	4.09	0.01	-0.09	-0.02
Philippines DHS-III	Asia	3	1998	62	3.73	0.03	-0.17	-0.04
Philippines DHS-IV	Asia	4	2003	65	3.53	0.07	-0.11	-0.03
Philippines DHS-V	Asia	5	2008	67	3.26	0.03		
Rwanda DHS-II	Sub-Saharan Africa	2	1992	66	6.23	0.01	-0.57	-0.08
Rwanda DHS-IV	Sub-Saharan Africa	4	2000	67	5.84	0.15	-0.38	-0.06
Rwanda DHS-V	Sub-Saharan Africa	5	2005	63	6.08	0.01	0.02	0.00
Rwanda DHS-VI	Sub-Saharan Africa	6	2010	71	4.56	0.04		
Sao Tome and Principe DHS-V	Sub-Saharan Africa	5	2008-09	69	4.90	0.15		
Senegal DHS-II	Sub-Saharan Africa	2	1992-93	72	6.03	0.09	-0.43	-0.07

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Appendix Table A1. – *Continued*

Survey	Region	Phase	Year	Reference period (months)	Published TFR (last 3 years)	Displacement index	Actual difference between published TFR and reconstructed TFR	Relative difference between published TFR and reconstructed TFR
Senegal DHS-III	Sub-Saharan Africa	3	1997	61	5.67	0.03	-0.22	-0.04
Senegal DHS-IV	Sub-Saharan Africa	4	2005	62	5.26	0.05	-0.11	-0.02
Senegal DHS-VI	Sub-Saharan Africa	6	2010-11	72	4.98	0.11		
Sierra Leone DHS-V	Sub-Saharan Africa	5	2008	64	5.12	0.24		
South Africa DHS-III	Sub-Saharan Africa	3	1998	62	2.90	0.10		
Swaziland DHS-V	Sub-Saharan Africa	5	2006-07	69	3.85	0.16		
Tanzania DHS-II	Sub-Saharan Africa	2	1991-92	71	6.24	0.09	-0.14	-0.02
Tanzania DHS-III	Sub-Saharan Africa	3	1996	67	5.82	0.14	-0.25	-0.04
Tanzania DHS-IV	Sub-Saharan Africa	4	1999	68	5.55	-0.02	-0.33	-0.06
Tanzania DHS-IV	Sub-Saharan Africa	4	2004-05	70	5.66	0.01	-0.11	-0.02
Tanzania DHS-VI	Sub-Saharan Africa	6	2010	61	5.43	0.08		
Timor-Leste DHS-VI	Asia	6	2009-10	69	5.68	0.14		
Togo DHS-III	Sub-Saharan Africa	3	1998	38	5.20	0.07		
Turkey DHS-III	MENA	3	1993	67	2.51	0.11	-0.33	-0.11
Turkey DHS-IV	MENA	4	1998	67	2.61	0.08	-0.06	-0.02
Turkey DHS-IV	MENA	4	2003	72	2.23	0.06		
Uganda DHS-III	Sub-Saharan Africa	3	1995	52	6.86	0.16	-0.62	-0.08
Uganda DHS-IV	Sub-Saharan Africa	4	2000-01	71	6.85	0.14	-0.66	-0.09
Uganda DHS-V	Sub-Saharan Africa	5	2006	66	6.67	0.16	-0.28	-0.04
Uganda DHS-VI	Sub-Saharan Africa	6	2011	67	6.20	0.03		
Ukraine DHS-V	Europe	5	2007	67	1.17	-0.01		
Uzbekistan DHS-III	Asia	3	1996	78	3.34	-0.04		
Vietnam DHS-III	Asia	3	1997	43	2.33	0.09	-0.21	-0.08
Vietnam DHS-IV	Asia	4	2002	45	1.87	0.00		
Yemen DHS-II	MENA	2	1991-92	58	8.78	0.14		

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Appendix Table A1. – *Continued*

Survey	Region	Phase	Year	Reference period (months)	Published TFR (last 3 years)	Displacement index	Actual difference between published TFR and reconstructed TFR	Relative difference between published TFR and reconstructed TFR
Zambia DHS-II	Sub-Saharan Africa	2	1992	61	6.46	0.05	-0.15	-0.02
Zambia DHS-III	Sub-Saharan Africa	3	1996	68	6.08	0.13	-0.52	-0.08
Zambia DHS-IV	Sub-Saharan Africa	4	2001-02	73	5.88	0.09	-0.26	-0.04
Zambia DHS-V	Sub-Saharan Africa	5	2007	65	6.17	0.00		
Zimbabwe DHS-III	Sub-Saharan Africa	3	1994	44	4.29	0.01	-0.33	-0.07
Zimbabwe DHS-IV	Sub-Saharan Africa	4	1999	68	3.96	0.00	-0.37	-0.09
Zimbabwe DHS-V	Sub-Saharan Africa	5	2005-06	69	3.80	0.04	-0.12	-0.03
Zimbabwe DHS-VI	Sub-Saharan Africa	6	2010-11	71	4.10	0.07		